Power Engineering

NOVEMBER, 1953

Volume 57, No. 11 Circulation of this issue 32,880

How to Reduce Voltage Dips..... 53

Outdoor Water Softening Plant..... 54

Standardized Industrial Boilers..... 58

Handle Your Chlorine Safely..... 64

Gage Glass Erosion..... 90

Complete Contents on Page 5

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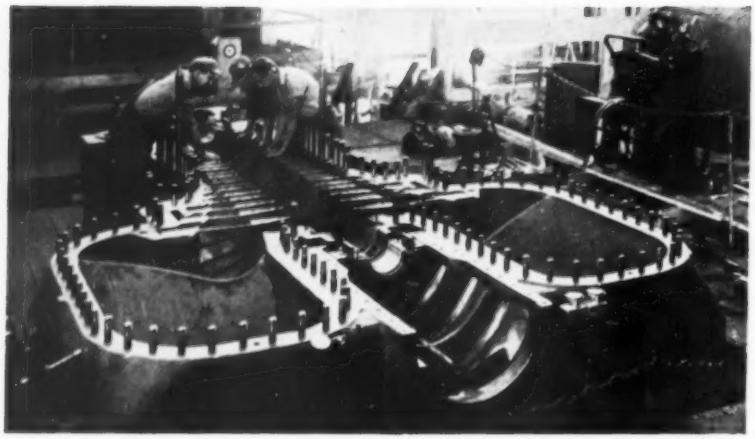
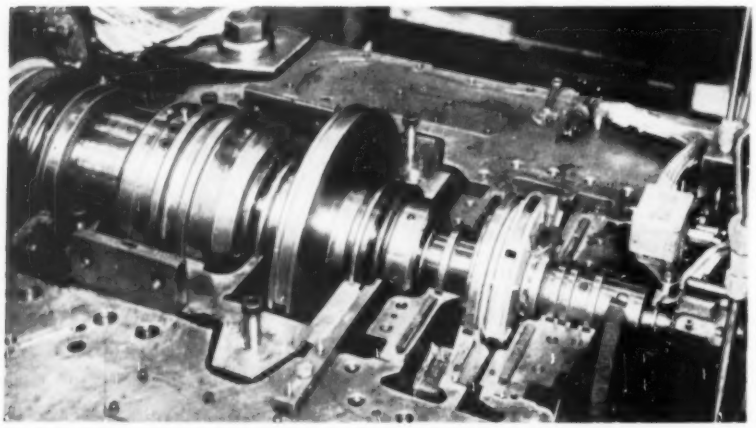
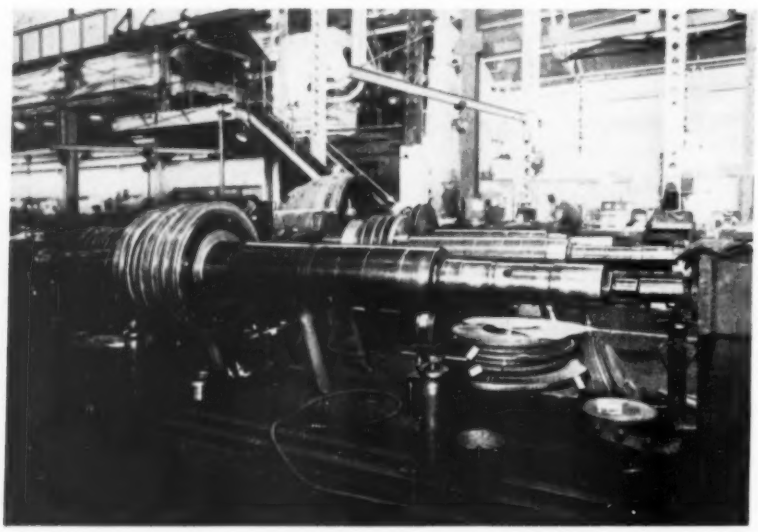


In a turbine alignment is everything. At left the initial factory alignment of bearings, shaft seals, and diaphragms is being checked and recorded so that it can be reproduced in the field, and design clearances established on assembly are maintained in operation.

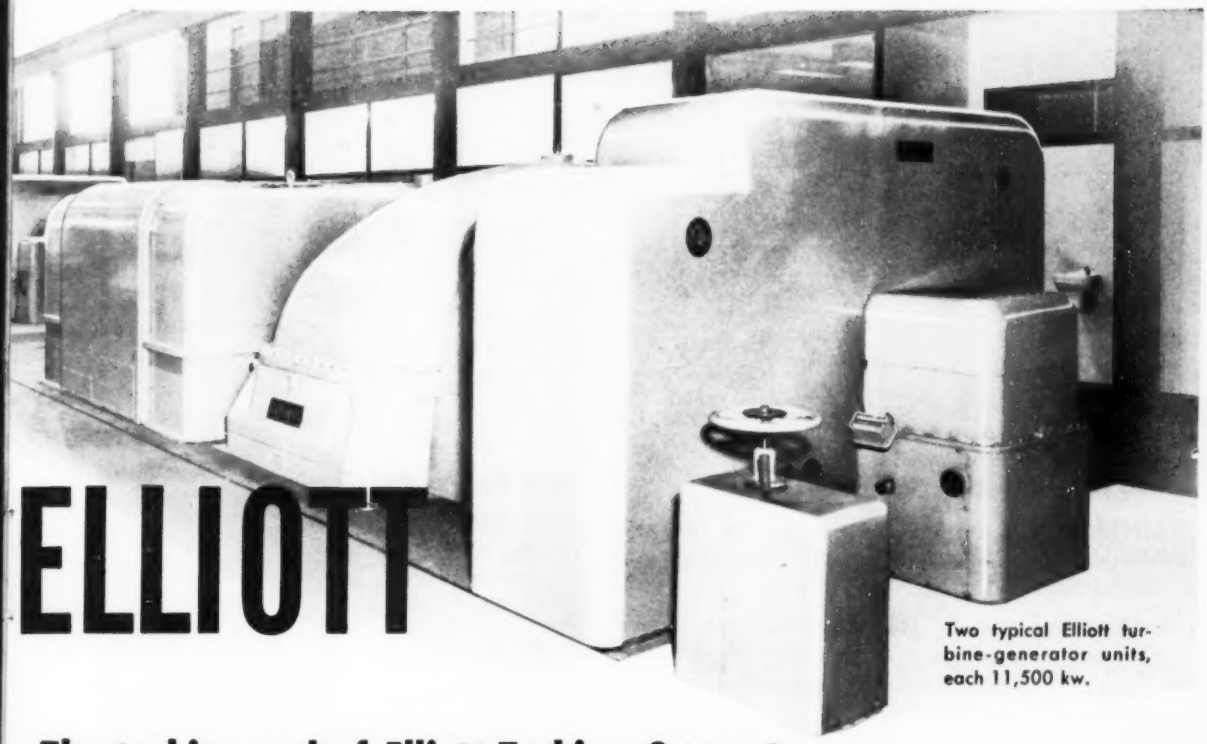
They build them well at



The steam end bearing case is arranged as a sliding pedestal to take up axial expansion. It carries the No. 1 bearing, thrust bearing, shaft-mounted main oil pump, overspeed trip pin, and speed governor. The centrifugal oil pump at 3600 rpm provides the reserve needed by the hydraulic control system, including sudden demands for large quantities of oil to move the valve servo motor on sudden load changes.



In turbine rotors initial temperature shocks in the first stages cause faster expansion in the disc than in the shaft. This would tend to relieve a shrink fit, thus upstream wheels for Elliott large, high-temperature turbines are forged integral with the shaft. In later stages temperature changes in disc and shaft are more nearly uniform, and the problem is replaced by that of higher stress due to the larger diameters and heavier blading. This increased physical stress is met by using special alloy discs shrunk on the shaft. Such individual discs have higher physicals than can be obtained in the large shaft forging and are therefore best suited to the higher blade loads, and with the low temperatures in these down-stream stages temperature changes do not affect the shrink fit.



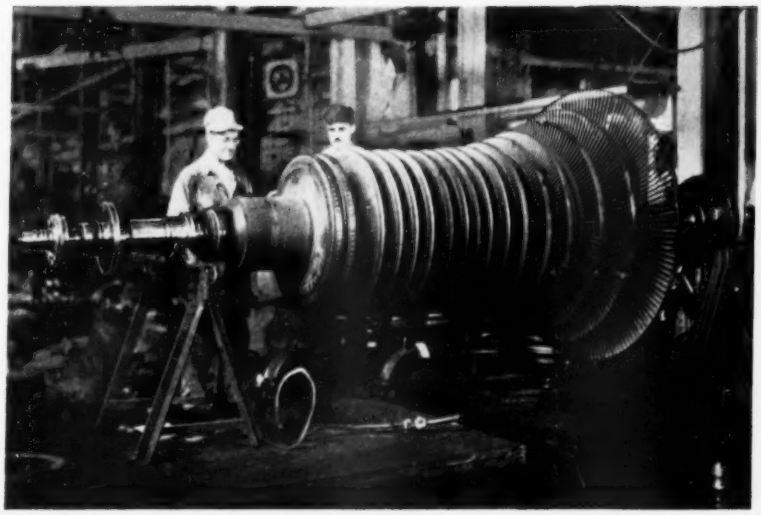
ELLIOTT

Two typical Elliott turbine-generator units, each 11,500 kw.

The turbine end of Elliott Turbine-Generators

exemplifies the extreme care and high degree of engineering skill that has become known as characteristically Elliott. Look over the pictures on these two pages—they speak for themselves. For full data on completely Elliott-built turbine-generators, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company
Steam Turbine Dept.



With the many physical and chemical checks on material going into the finished rotor, is the final inspection after the shake-down run at speed and overspeed on the test block. While material control during each step in manufacture minimizes the hazard of test operational failure, the final proof of the rotor lies in black light inspection for cracks in shrouding and other parts.

H33

For more data circle 501 on Post Card

How to Figure the cost of STEAM TRAPS

1. PRICE—you get a lot of trap for your money when you buy an Armstrong: big capacity in small size; the long-lasting mechanism in traps for low and medium pressures is identical in design, workmanship and materials, to that in traps for 900 degrees, 950 lbs. pressure!

2. INSTALLATION—Armstrong gives you a choice of body styles to save installation labor and pipe fittings.

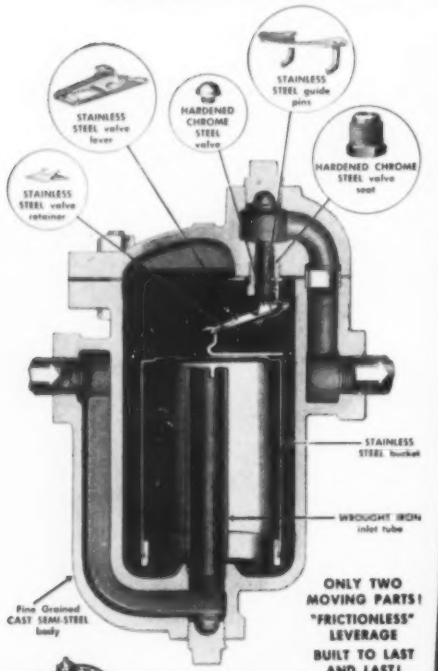
3. MAINTENANCE—Armstrong traps last longer! You save labor, parts cost and downtime. Freedom from leakage saves fuel.

Divide total trap cost by the life of the trap to get *costs per year*—this is where Armstrong traps really shine. Call your Armstrong Representative for the traps you need now, or write:

ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

Full Facts In
FREE Catalog J

Catalog J, also an educational handbook on condensate drainage, gives sizes, prices and capacities of Armstrong traps. It tells how to select traps; how to make hook-ups; how to trouble-shoot. Send for a copy today.


STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer
STAINLESS STEEL bucket
WROUGHT IRON inlet tube
Fine Grained CAST SEMI-STEEL body
ONLY TWO MOVING PARTS!
"FRICTIONLESS" LEVERAGE
BUILT TO LAST AND LAST!

STEAM TRAP CHECK LIST	ARMSTRONG TRAPS
Hardened chrome steel valve and seat?	Yes
All other parts stainless steel?	Yes
Long-lasting "frictionless" leverage?	Yes
Self-cleaning, non-clogging operation?	Yes
Choice of body styles?	Yes
Available with built-in strainers?	Yes
Available with internal check valves?	Yes
40 years inverted bucket trap experience?	Yes
Guaranteed *unconditionally* to satisfy?	Yes

ARMSTRONG STEAM TRAPS COST LESS!

For more data circle 502 on Post Card

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NOVEMBER 1953
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Repair work progresses on an exhauster fan in a high-capacity pulverized fuel system

Power Engineering

How to Reduce Line Voltage Dips When Starting A-C Motors.... 53
By Edward H. Stivender

Outdoor Water Softening Plant for Bayway Refinery..... 54
By Oscar Shepstone and George Wolfe

Power for the Pullman Laundry..... 57

Standardized Industrial Boilers Can Keep Your Steam Costs Down 58
By Carl E. Miller

Oak Creek's "Fair Weather" Slip Saves Money, Speeds Coal Handling..... 62

Handle Your Chlorine Cylinders Safely..... 64

Losing Refrigeration Dollars This Way?..... 66
By C. T. Baker

How Much Paint Do You Need?..... 68
By L. G. Jones

Standard D-C Motor Connections and Terminal Markings..... 71

Distribution Transformers Start Korean Diesel..... 72
By Robert S. Horn

POWER ENGINEERING NEWS REEL..... 74

Traveling Steam Plants..... 76

The Free Piston Gas Turbine..... 77

Choose Right Oil and Gas Burners..... 78
By Paul R. Unger

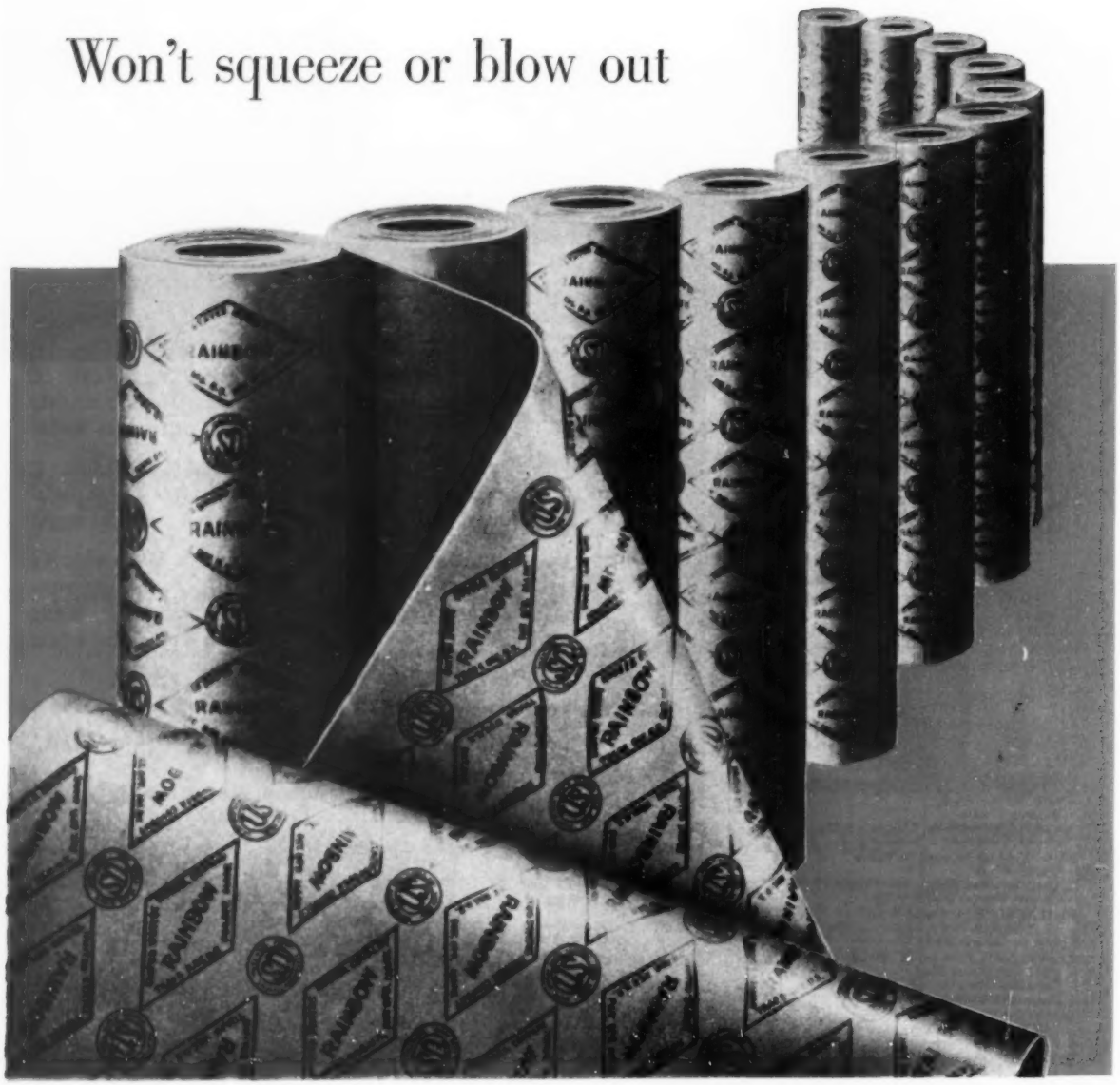
Practical Engineer and Electrician Section — Contents..... 81

REGULAR DEPARTMENTS

Engineers' Preview	7	Construction News	48
Helpful Bulletins	35	Obituaries	110
Equipment News	42	New Engineering Books	112
Catalog Library	118		

The only magazine devoted exclusively to the job interests of power engineers

Won't squeeze or blow out



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For more data circle 503 on Post Card

ENGINEERS' PREVIEW

A GROUP of five large electric power utility companies in the south central states has announced the purchase and initial construction of an extensive microwave relay system. The complex radio communications network, reported to be the largest (in terms of channel miles) of its type in the world, will extend into three states: Louisiana, Mississippi and Arkansas. When completed, the system will facilitate supervision and control of electric power distribution for consumers served by Gulf States Utilities, Inc. and Middle South Utilities, Inc. The latter organization includes the Louisiana Power & Light Co., Arkansas Power & Light Co., Mississippi Power and Light Co., and New Orleans Public Service, Inc.

* * *

NAME of Rockland Light & Power Co.'s main steam plant at Tomkins Cove, N. Y., will be changed from Hudson Plant to Lovett Plant in honor of Fremont L. Lovett, former Rockland Light and Power president who was killed June 13 in an accident involving his own aircraft at Warren, Vt. (POWER ENGINEERING, August, 1953). This plant, with a present capacity of 44,000-kw and an additional 66,000-kw unit now under construction, will constitute a dynamic, lasting and appropriate memorial to a man of Mr. Lovett's great force of character, courage and energy.

* * *

FRED C. KELLOGG, president of Pioneer Service & Engineering Co., has announced important changes among executive personnel of the engineering department of the company, effective July 1, 1953.

E. D. Uhlendorf, senior vice president, who has been in charge of engineering for the past 26 years, becomes vice president and consultant. Warren C. Drummond, formerly vice president and chief engineer, now becomes vice president in charge of engineering, succeeding Mr. Uhlendorf as active head of engineering activities.

Noah C. Pearcy, now chief electrical engineer, will succeed Mr. Drummond as chief engineer and Henry L. Hoeppner, formerly senior electrical engineer, becomes chief electrical engineer.

Amasa C. Bull, vice president, retires as head of the purchasing section, to take up special assignments. Eugene V. Cullen assumes Mr. Bull's former duties.

* * *

PLANT WHAT'S-ITS-NAME, also referred to as Plant X, is now under construction by the Toledo Edison Co. At this writing it has no other name. It will be located on Maumee Bay, several miles north of Toledo and the first unit will be of 135,000-kw capacity designed for 1800 psi, 1050 F steam temperature.

* * *

WORKING Together for Safety is the title of the National Safety Council's new employee rules manual. The handy 32-page booklet contains instructions in safe work habits applicable to employees in most plants. For a free sample copy and prices for quantities, write the National Safety Council, 425 North Michigan Ave., Chicago 11, Ill.

Important Notice
Sources of Information on Atomic Power

OAK RIDGE Technical Information Branch of the AEC has called our attention to a typographical error in our reference to Document MDDC-1104 in the above article, July 1953 issue. This reference should read MDDC-1014.

Also, this document (Course in Nuclear Physics for Engineers, MDDC-1014) as well as document AECD-2664, Neutron Physics, are now sale documents available from OTS, Commerce Department, Washington, D. C. So, in writing for these documents, please address OTS, Commerce Department, Washington, D. C.

Finally, we regret very much that our stock of reprints of the Atomic Power Section published in the June issue of POWER ENGINEERING is exhausted, hence we are no longer able to supply copies of this section.

ATOMIC ENERGY COMMISSION has awarded a contract to Walter Kidde Nuclear Laboratories, Inc., to make a design study of "a nuclear power plant for use in an isolated high-cost power area," it was announced simultaneously in Washington and New York.

The study will concentrate on a nuclear power plant of 30,000-kw capacity. The plant would be a "single purpose" reactor designed to produce power only, and it would use light water as a moderator and coolant. "An isolated high-cost power area" is a place where electrical power is not readily accessible at usual costs, such as desert areas where power may be needed, or at off-shore locations where conventional fuel will not permit economical power generation.

A "single-purpose" reactor is one designed specifically for a single purpose — in this case the production of power, as compared with "dual purpose" reactors providing for production of plutonium and power as co-products.

* * *

EFFORTS of large companies to diversify their lines are going ahead on such a vast scale that they amount to a tremendous economic revolution, according to the August report of the York Engineering and Construction Co. The report says that companies are spreading themselves horizontally as never before and extending roots into every conceivable market. This trend is termed a colossal hedge against future economic variations. Lateral diversification is being approached in two ways: by mergers and by adding new lines.

* * *

MORE POWER for more wind-tunnel work at the Langley Aeronautical Laboratory, Langley Field, Va. There is a 19-ft wind tunnel and it will be repowered by new Westinghouse equipment. The existing sub-sonic tunnel structure will be converted into a trans-sonic tunnel by replacing the present 8000-hp motor and fan by a new 20,000-hp drive and fan. The new motor will be installed in the tunnel and will be enclosed by the fan nacelle. In addition, a 25,000-kva transformer with 22-kv and 110-kv high-voltage taps, a liquid rheostat for secondary control of the wound-rotor motor, and certain auxiliary equipment will also be supplied by Westinghouse.

IF ELECTRIC furnaces replaced open hearths in the manufacture of 89 per cent of all steel made in the United States, the electric utility industry and the coal industry would benefit materially. So the coal, steel, and electric utility industries have been conducting a research project, just completed by 14 electric utility companies and Bituminous Coal Research, Inc., in which they conclude that these three industries could make or save many millions of dollars by using electric furnaces instead of open hearths, thus decreasing cost of making low carbon steel, increasing national output of electricity by 12 per cent and increasing coal production about 25,000,000 tons a year. Open hearths are fired primarily with oil; electric furnaces operate on power, usually generated from coal.

* * *

PERHAPS you don't need, just at this moment, an electrocardiograph record of a whale while he is diving and spouting. But, if you ever do, we know where you can get one. Of course, you know that a mouse has a heart rate of 600 to 700 per min and an elephant 20 to 30 per min. Well, anyway, the scientists of the Sanborn Co., manufacturers of electrocardiographs and other precision instruments, thought they would like to find out about heart rate of the whale, the largest mammal.

So Sanborn's president James L. Jenks, Jr., together with Dr. Paul Dudley White, Boston's renowned cardiologist, flew to Alaska, embarked in a whaleboat at the proper time, accompanied by a harpooner, and set out to find a school of whales. They found them and the harpooner shot two harpoons with perfect aim into one of the white Beluga whales to give the proper electrocardiograph circuit. It turns out that this particular whale's heart rate was 15 to 20 per min under water.

Now, what has all this got to do with power plant work? The connection is that Dr. Frank B. Sanborn, founder and now chairman of the board of Sanborn Co., was this writer's professor of civil engineering, and especially hydraulics, a couple of years before he founded his present company.

At that time, Dr. Sanborn pounded the fundamentals of fluid flow so firmly into our head that we can still understand most flow meter calculations and pipe and valve sizing calculations and even Reynolds numbers — we think!

* * *

APPROACHES — Finding the Range (approaches to meaningful decision) is a 12-page booklet, volume 4, in the series being issued by Creative Thinking Institute, 738 Sheridan Road, Chicago 13, Ill. This booklet is a continuation of a preceding issue entitled, "Looking Ahead" in the Institute's general series on how to solve practical problems.

For further information about the Institute's work and its publications write to Zuce Kogan, director of the Institute at the above address.

* * *

COMBUROLOGY, a new approach to problems of fire prevention and protection, is described in a new book by Gilbert E. Stecher. Mr. Stecher originated the term, which literally means the study of combustion, to tie together the many phases of fire prevention and protection.

CYBERNETICS may be a big factor in providing for a second industrial revolution. So said J. Stanford Smith of General Electric before the 1953 G. E. Professors Congress meeting recently at Lake George.

Mr. Smith explains cybernetics as basically the science of communication and control that makes use of five human senses in machines.

As examples he pointed to the photoelectric cells that see, the microphones that hear, the gas detectors that smell, the radar sensitive to touch, and the acidity detectors that taste. By coordinating these human factors in machines, he said, we get cybernetics and from that, automatic factories with new productive efficiency.

As a result of this cybernetic revolution, man will be further relieved as a beast of burden. Continued upgrading of men in human jobs will require more education which can be applied to increase further the living standards of the world and cut down drudgery. With the resulting new freedom for the human spirit, however, Mr. Smith warned that it will bring a moral responsibility to use the increased power wisely and not permit technical resources to tempt the nation into pride and domination.

* * *

KARL M. BAUSCH has been appointed chief electrical engineer for the Power Division of Bechtel Corp. Mr. Bausch, a member of the Bechtel engineering staff since 1937, has been chief electrical engineer of the Refinery Division. His new duties encompass the over-all direction of electrical engineering on all Power Division projects, principally in the fields of steam and hydro-electric generating plants and electrical transmission and distribution systems at San Francisco.

* * *

REVISED edition of "Your Skill Improvement Program" has been issued by the U. S. Department of Labor's Bureau of Apprenticeship.

This 16-page booklet, designed to help the employer develop a skill improvement program, contains a check list for the employer's use in making spot evaluations of his current training system and training needs. It also outlines services of the Bureau which are available to the employer in establishing training programs to meet those needs.

Copies of this new edition may be obtained from the Publications Branch, Bureau of Apprenticeship, U. S. Department of Labor, Washington 25, D. C.

* * *

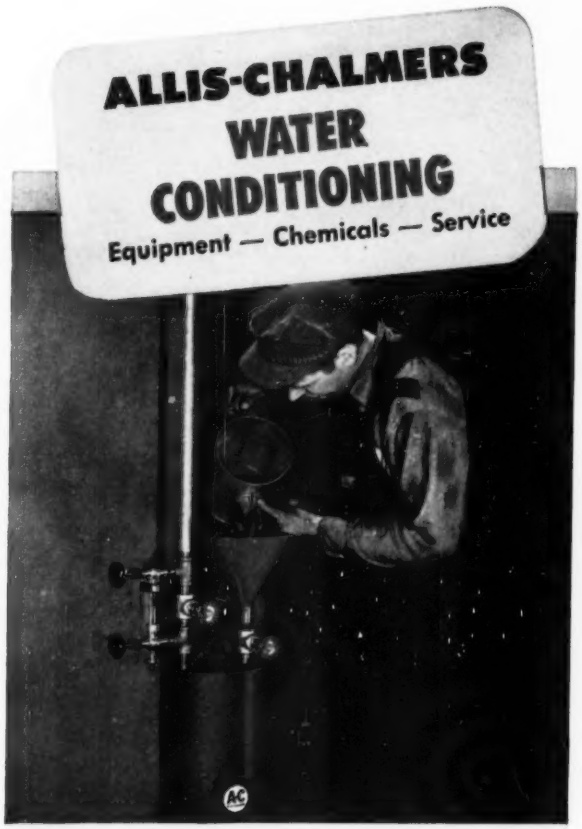
TO MANUFACTURE general purpose controls for industrial use, a $5,000,000 General Electric plant will be built at Bloomington, Ill. The plant will produce a complete line of electric controls including starters for motors ranging up to 200-hp, push-buttons, compensators, and many other devices used in industry. Such products up to now have been manufactured at the Schenectady Works. Operations will not begin at Bloomington until late 1954, when the plant is scheduled to be completed.

* * *

CHARLES H. SPINK is now engineer-in-charge of the Federal Power Commission office at Fort Worth, Tex. He succeeds E. L. Burnett who is now at Grand River Dam as chief engineer.

How to Solve Boiler Problems caused by

HIGH CIRCULATING RATES



Equipment for all water treatments is available from Allis-Chalmers. Picture shows feeder installation similar to equipment used in water side protection of boiler surfaces.

Recent trends toward high circulating and high heat transfer rates mean that careful attention to water side protection of boiler surfaces will pay off in lower fuel costs and easier maintenance. Information that will help you analyze this problem and work out an effective solution is contained in Allis-Chalmers water conditioning Bulletin 43. It explains the problem. It tells what solution is available. And it tells how to apply this solution.

Based on Allis-Chalmers Experience

Bulletin 43 is one of a series of Allis-Chalmers bulletins on water conditioning problems. Each of these bulletins contains information that will help you solve some of your problems. They are based on Allis-Chalmers wide experience handling water problems for nearly every industry. In addition, they are based on Allis-Chalmers long experience building steam turbines and power plant equipment.

Complete Service Available

Allis-Chalmers gives you complete water conditioning service. You can get analyses and reports on your problems. You can get the chemicals needed in all water treatments. And you can get the equipment needed in any system.

A-4035

For your copy of Bulletin 43 on internal treatment for water side protection of boiler surfaces, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby Allis-Chalmers district office and have an Allis-Chalmers representative consult with you on your water problems.

ALLIS-CHALMERS

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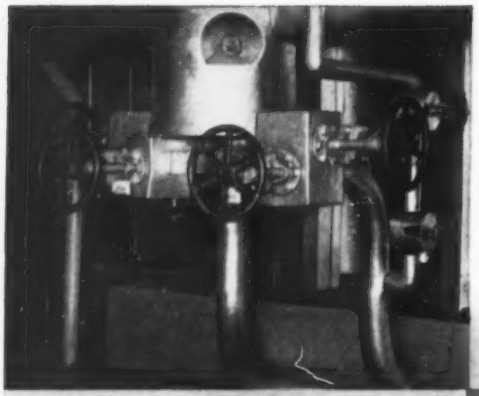
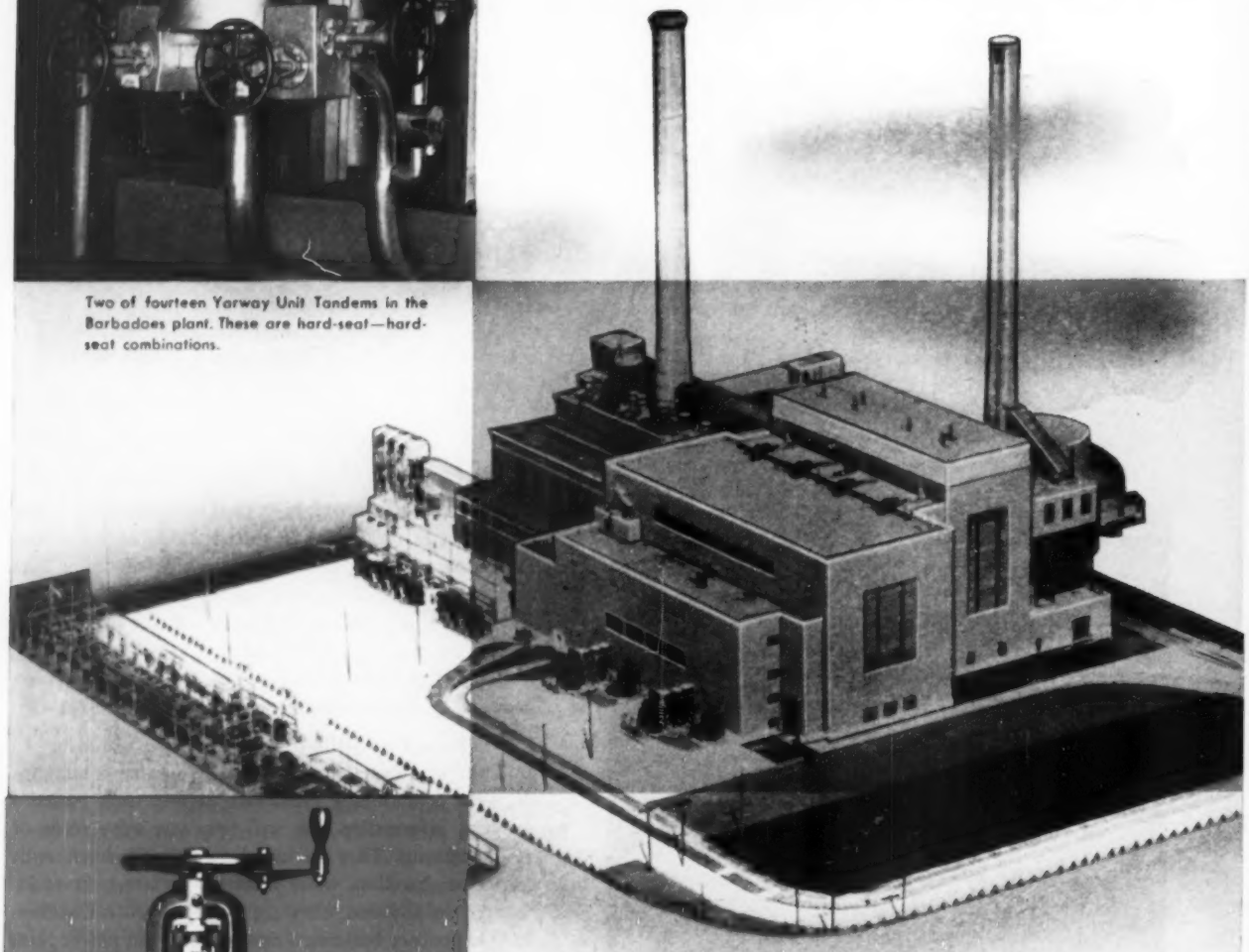
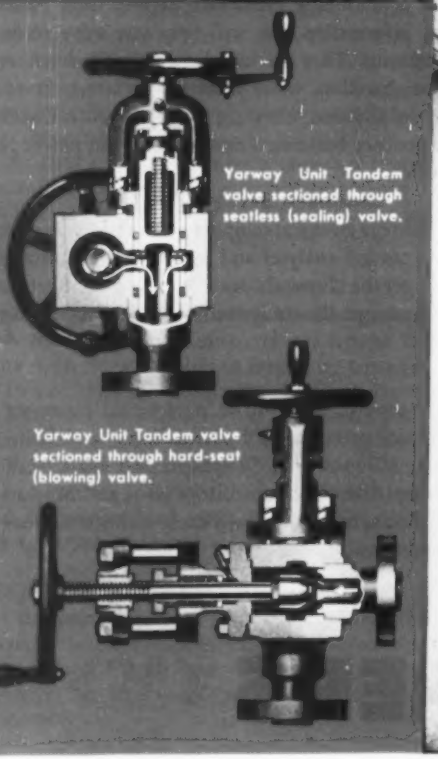


Two of fourteen Yarway Unit Tandems in the Barbadoes plant. These are hard-seat—hard-seat combinations.

BARBADOES BOILERS GET





Yarway Unit Tandem valve sectioned through seatless (sealing) valve.

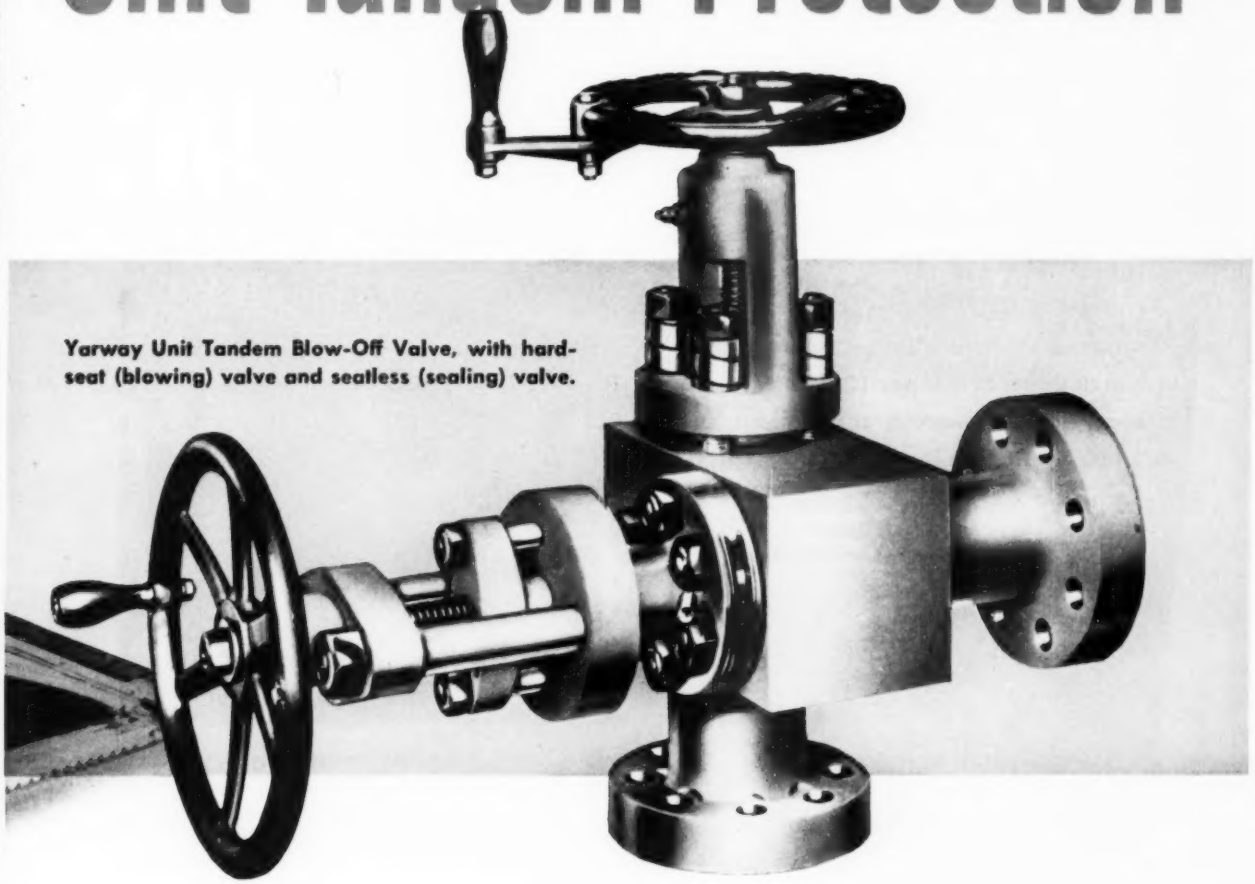
Yarway Unit Tandem valve sectioned through hard-seat (blowing) valve.

■ When a company has a $25,000,000.00 stake in the future such as Philadelphia Electric Company does in its Barbadoes Station —then protects the boilers of that plant with Yarway Unit Tandem Blow-Off Valves—it's significant of the dependability of those valves.

Barbadoes is a fine example of modern power plant engineering, demonstrated by the fact that only 11 men per shift are needed for operating this 180,000 KW station.

YARWAY

Unit Tandem Protection



Yarway Unit Tandem Blow-Off Valve, with hard-seat (blowing) valve and seatless (sealing) valve.

Yarway Unit Tandem Blow-Off Valves also are a good example of steam equipment engineering—used in more than 4 out of 5 high pressure boiler plants in the country.

Rugged construction makes Yarways strong and tough enough to withstand severest blow-down conditions. Metallurgical improvements make them resistant to the reactions of periodic acid wash. *Outages are rare where Yarway boiler valves are used.*

Unit tandems are available in various combinations to meet all pressure and service requirements.

Write for Bulletin B-433 for full details on Yarway Unit Tandems. For lower pressure blow-off valves, write for Bulletin B-424.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

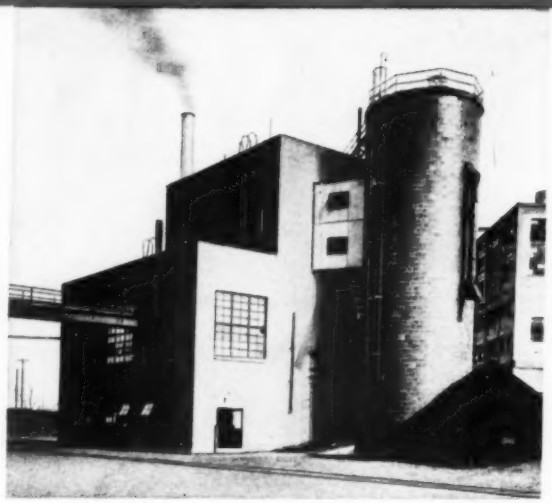
STEAM PLANT EQUIPMENT

For more data circle 505 on Post Card

Quaker Oats BURNING COAL

"Our new coal installation produces steam at a cost of 32¢ per 1000 lbs.... reduces some operating costs about one half,"

says Walter H. Proescholdt
Asst. Chief Engineer
The Quaker Oats Company



To gain economy plus dependability, Quaker Oats Company modernized the boiler room in its paper-making plant. One efficient, coal-fired unit now supplies all steam needed for heating, processing, and power generation.

Boiler and turbine room operations combined. With automatic controls and coal- and ash-handling systems, two men per shift can operate the combination boiler and turbine generator room shown above, right. Quaker Oats has found that burning coal the modern way certainly increases efficiency of operation and cuts operating costs.

Additional case histories, showing how plants of other types have saved money by burning coal the modern way, are available upon request.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

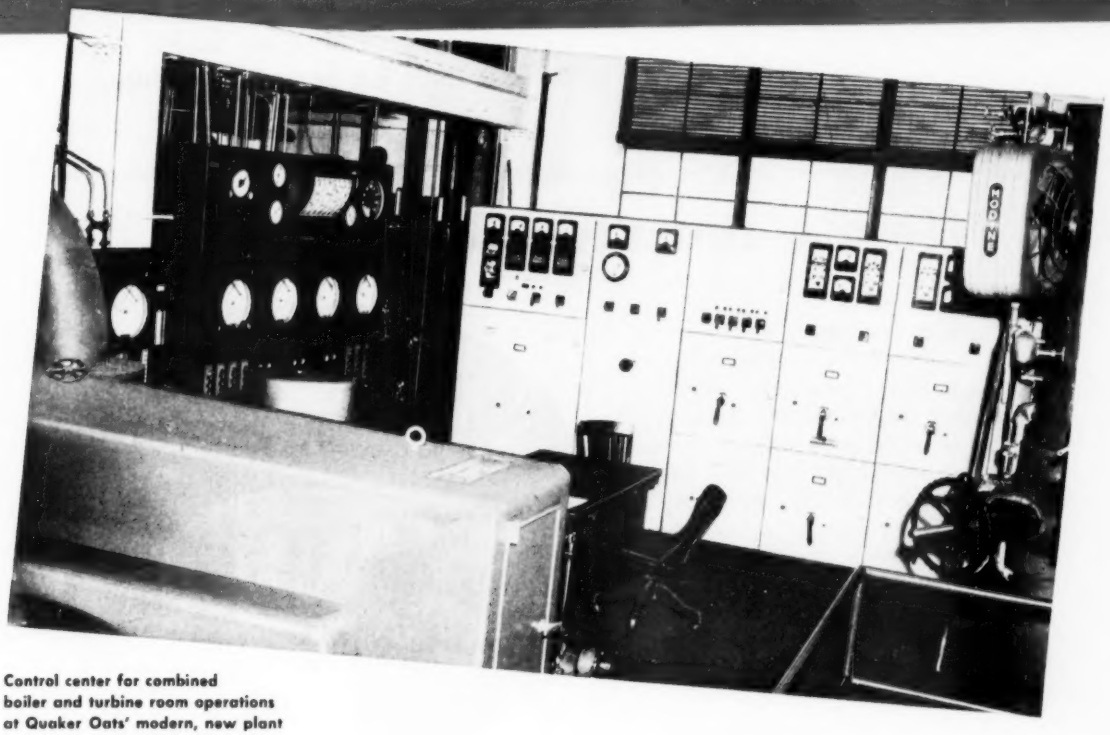
COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

REDUCES STEAM COSTS BY THE MODERN WAY



Control center for combined boiler and turbine room operations at Quaker Oats' modern, new plant

Many power plants over ten years old are as dated in efficiency as the automobiles of the same period. Ton for ton, coal burned in a modern plant can produce 10% to 40% more power. Modern coal- and ash-handling equipment can also cut labor costs substantially.

Why not let a consulting engineer look over your plant? Chances are he can point out ways of remodeling so that you can burn bituminous coal the modern way . . . and save dollars.

It pays to burn coal efficiently, because coal is not only an economical, but a dependable fuel. Coal reserves are virtually unlimited. America's coal industry is the world's most efficient and progressive. Thus you're assured of a plentiful supply of coal at relatively stable prices for generations.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Southern Building, Washington 5, D. C.

YOU CAN COUNT ON COAL!

For more data circle 506 on Post Card

How you gain by specifying R/M's BIG 7 packing types

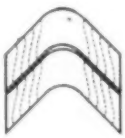
You lower inventories! Simplify your ordering! Reduce your downtime! No longer must you have 10, 20, 30 different types of packings to satisfy your plant's requirements. Unless you have extremely rare packing applications, just three or four of R/M's new basic line of seven field-tested packings will meet all your needs. To find out how, call in your distributor.

Here's the story on TYPE 7

Type 7 is R/M Vee-Flex®. The success of Vee-Flex is its special design by which pressure from the medium being packed transmits itself through the packing to produce positive sealing against the stuffing box wall and rod. This is accomplished by R/M's unique convexly curved surface on the pressure side of the packing. Photoelastic analyses,* corroborated by radial pressure tests,* prove that maximum sealing performance occurs at a point slightly below mid-width on the sealing area.

**Performed at the Franklin Institute Laboratories for Research and Development*

Simplified diagram of stress trajectories in R/M Vee-Flex Rings with convexly curved surfaces.



Simplified diagram of stress trajectories in ordinary V-type rings with flat contact surfaces.

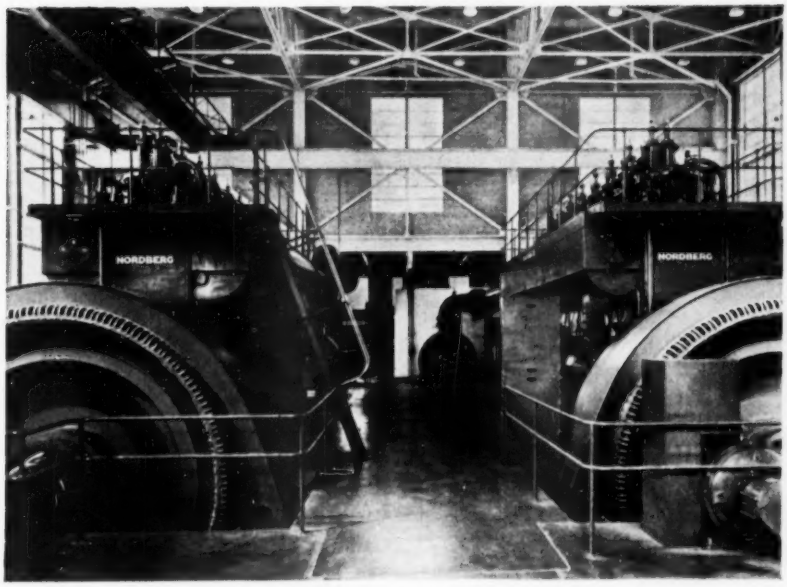
R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Teflon Products • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

For more data circle 507 on Post Card

W. T. Elliott,
Power Plant Supt.,
says...



"We've Got Facts to Prove Rubilene's Superiority"

A lot of people depend on Mr. W. T. Elliott. For it's his job as Power Plant Supt. to see that the City of Denton, Texas has unfailing light and power 24 hours a day. To help live up to that responsibility, Mr. Elliott pampers his hard working Nordberg Duafuel® engines — makes sure they're lubricated with the finest oil available. He says, "We've been using Sinclair RUBILENE® since 1948 with *very satisfactory results*. Cylinder liner wear is only ⅓ of 0.001 inch per 1,000 hours running. Piston ring life is 16,000 hours of operation and we get 6,100 H.P. hours per gallon of oil... Facts like those have definitely sold me on RUBILENE."

Why not let the facts prove to you, too, RUBILENE is a superior lubricating oil. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacements

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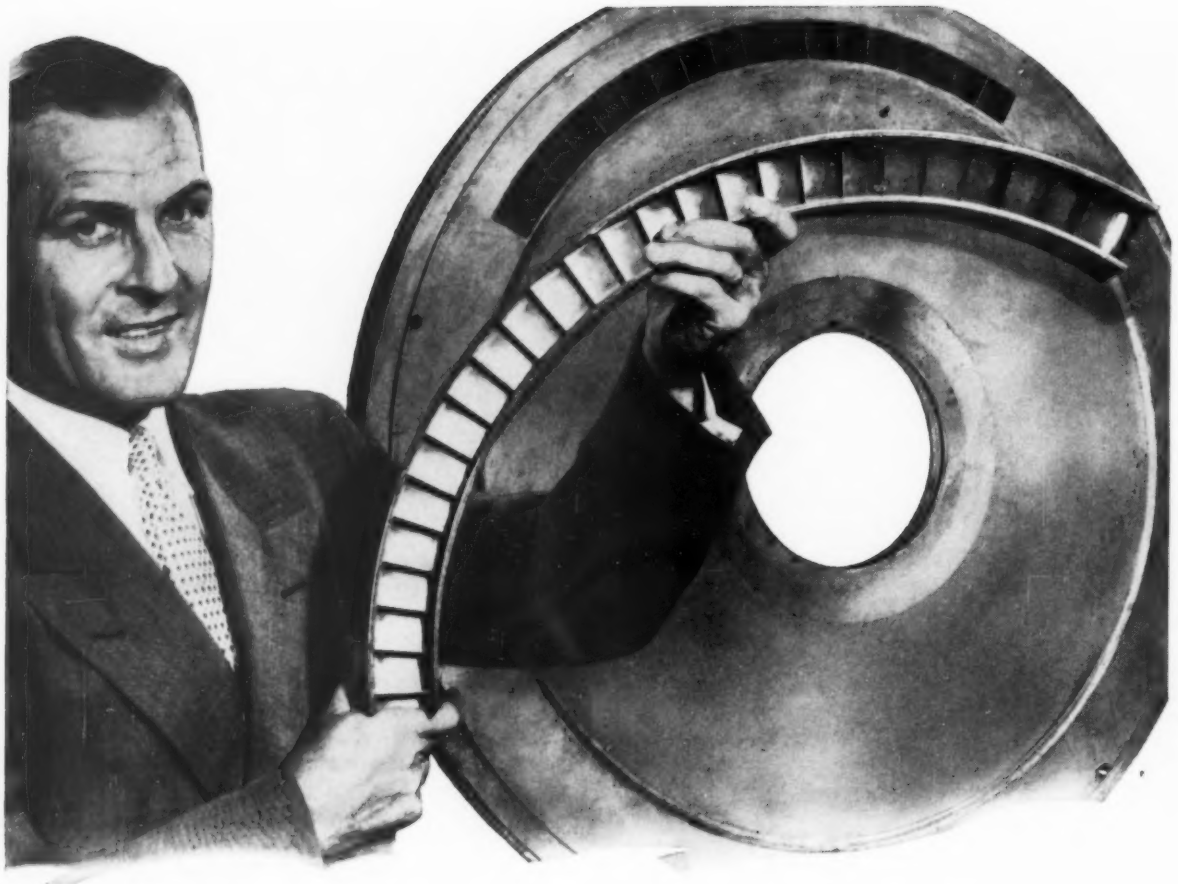


"This weld-free steam path speeds steam flow, preserves turbine efficiency"

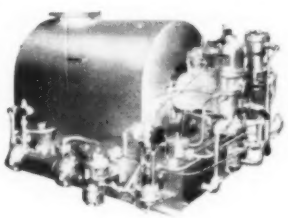
One reason for the higher, *long-term* efficiencies in Westinghouse Turbines is the special attention given to *preserving* the designed steam flow path. Example: diaphragm nozzle sections where every single weld fillet has been *eliminated* from the steam path. Here's how:

The nozzle vanes are first assembled between inner and outer strips, held in a precision jig. The nozzle vanes project into accurately spaced holes in the strips. This permits welding around the *outside* of the section—*completely* away from the steam path. The complete section is then welded into the diaphragm. Specially engineered for use in multi-stage turbines, this precise manufacturing technique provides an absolutely smooth and accurate steam path without the slightest weld fillet or other deviation from design to impair stage-to-stage flow. It is extra assurance that driving power and efficiencies will be maintained throughout the life of the turbine.

The weld-free diaphragm nozzle is just one of the continuing engineering refinements Westinghouse uses to give its turbines unusual *long-term* efficiency. The knowledge and manufacturing techniques gained from over 50 years' experience—on 1 hp to the largest made—make possible this and the many other features which deliver decade after decade of unfailing service. Make sure your next steam drive has *long-term* efficiency. Expert Application Engineers will help you select the right unit from a complete line of General-Purpose Turbines. Call your local Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-50561

Multi-stage, Single-valve, General-purpose Turbine

One of the multi-stage line which benefits from improved steam flow using weld-free diaphragm nozzles. Available in ratings from 100 to 2000 hp, 1000 to 7500 rpm, for driving all types of pumps, fans, compressors, generators and special-purpose machines. This advanced design is adaptable to almost any steam condition.

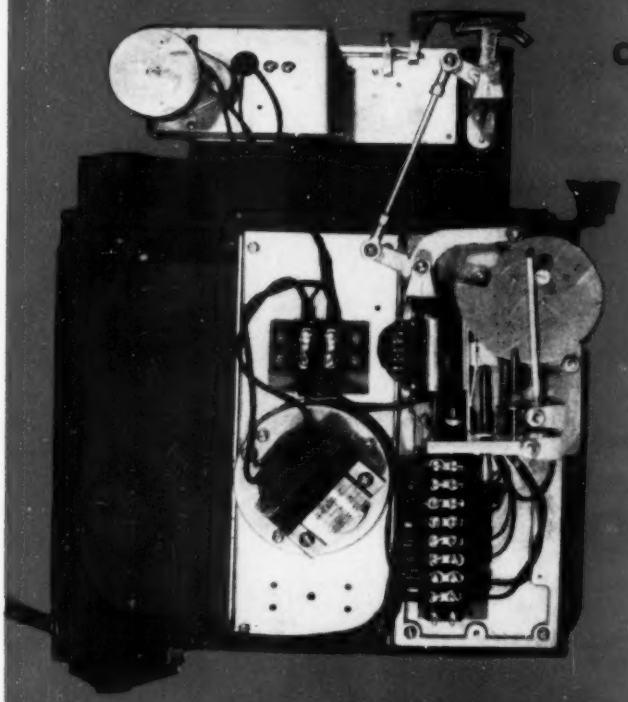


YOU CAN BE SURE...IF IT'S Westinghouse

Turbines for every industrial use

For more data circle 509 on Post Card

a new electronic flow meter!



Choice of 3 mercury-less transmitters

Hays Barton flow or differential transmitter

Hays differential transmitter

Hays liquid level transmitter

continuous integration —no creep at zero

unaffected by normal voltage, frequency and temperature changes

electronic operation provides high speed and greater accuracy

3 to 1 range calibration at recorder

HAYS Electronic Flow Meter

Since the circuit is of the electronic null-balance type, it is unaffected by normal voltage and frequency variations. Also, neither temperature variations nor reasonable length of transmission lines affect the calibration of the instrument.

The *pen-drive motor* is built for reversing duty. Normal variations in voltage and frequency have no noticeable effect on its operation.

The *integrator* is continuous in operation and simple in mechanical construction. A micrometer zero adjustment for calibration is easily accessible.

Indicators can be calibrated to read directly in rate-of-flow or other factors as desired.

Write today for full information on the Hays Electronic Flow Meter Bulletin 52-1074-222.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 7, INDIANA

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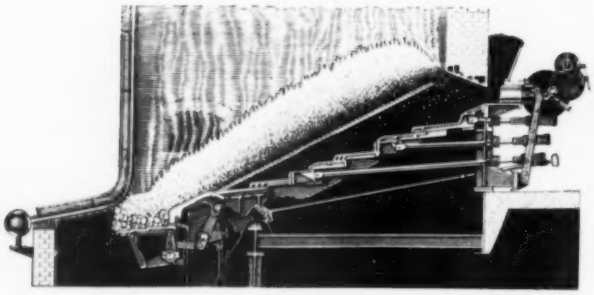


TAYLOR UNDERFEED STOKER

5 ways better than aspirin

FIVE DIFFERENT HEADACHES have often been inseparably connected with stoker operation... and every one of them is eliminated by the modern, engineered AE Taylor Stoker.

CO_2? That's where Taylors give you unrivaled efficiency. *Quick load response?... complete dependability?* Taylor Stokers are completely tops in both respects. *Stack discharge nuisance?* Taylors meet the toughest municipal ordinances. With proper grate area, over 98% of the ash goes to the pit. *Burning versatility?* Properly proportioned, Taylors can and do burn coals satisfactorily from all over the U.S., and from Canada, England and the Continent as well.

Whether your new plant must generate 20,000 or 500,000 pounds of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us today for booklet telling the whole Taylor story.

AMERICAN ENGINEERING COMPANY

2408 ARAMINGO AVE., PHILADELPHIA 25, PA.

IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Le-Hed Hoists, Le-Hed Car Pullers.

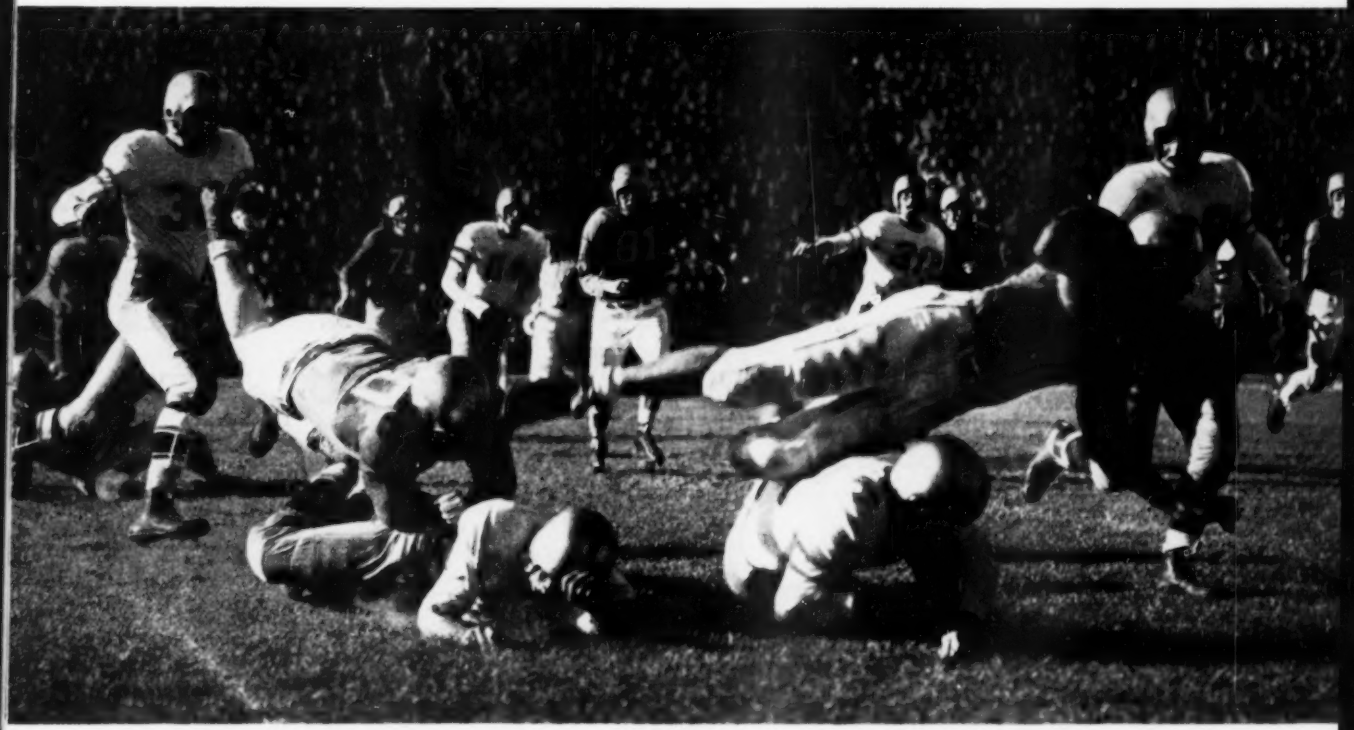
For more data circle 511 on Post Card

STAR PERFORMERS

From coast to coast, Powell Valves have won enthusiastic approval. For *every* Powell Valve is a *star for outstanding performance*. They have a record of dependability since 1846.

Small wonder that Powell Valves have made such a hit through the years. Powell has probably done more valve research, solved more valve problems and makes more types of valves than any other organization in the world.

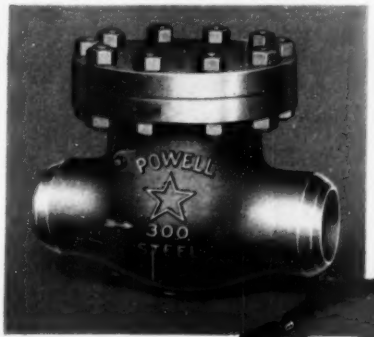
We're sure that *you* will be enthusiastic about Powell Valves too once you see how they perform. Following are just a few members of the Powell all-star cast of valves which are available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.



INTEGRAL BONNET CAST STEEL "Y" VALVE *(Fig. 1314-A)* 1500 pound. The one-piece construction eliminates possibility of leakage between body and bonnet. Sizes ½" to 2", inclusive.

BRONZE "W.S." FULL FLOW GLOBE VALVE *(Fig. 2608)* for 200 pounds W.P. Regrindable, renewable, hardened stainless steel seat and disc. Nominal pipe size opening through seat permits fuller flow, with pressure drop and turbulence cut to minimum.

WELDING END CAST STEEL SWING CHECK VALVE *(Fig. 3061 W.E.)* 300 pounds. Bolted flanged cap. Heavy rugged construction. Available in sizes 1" to 12", inclusive.



PRESSURE SEAL CAST STEEL GATE VALVE *(Fig. 11303)* 1500 pound. Many proven advantages and exclusive features. Pressure Seal Non-Return, Check, Globe and Angle valves also available.

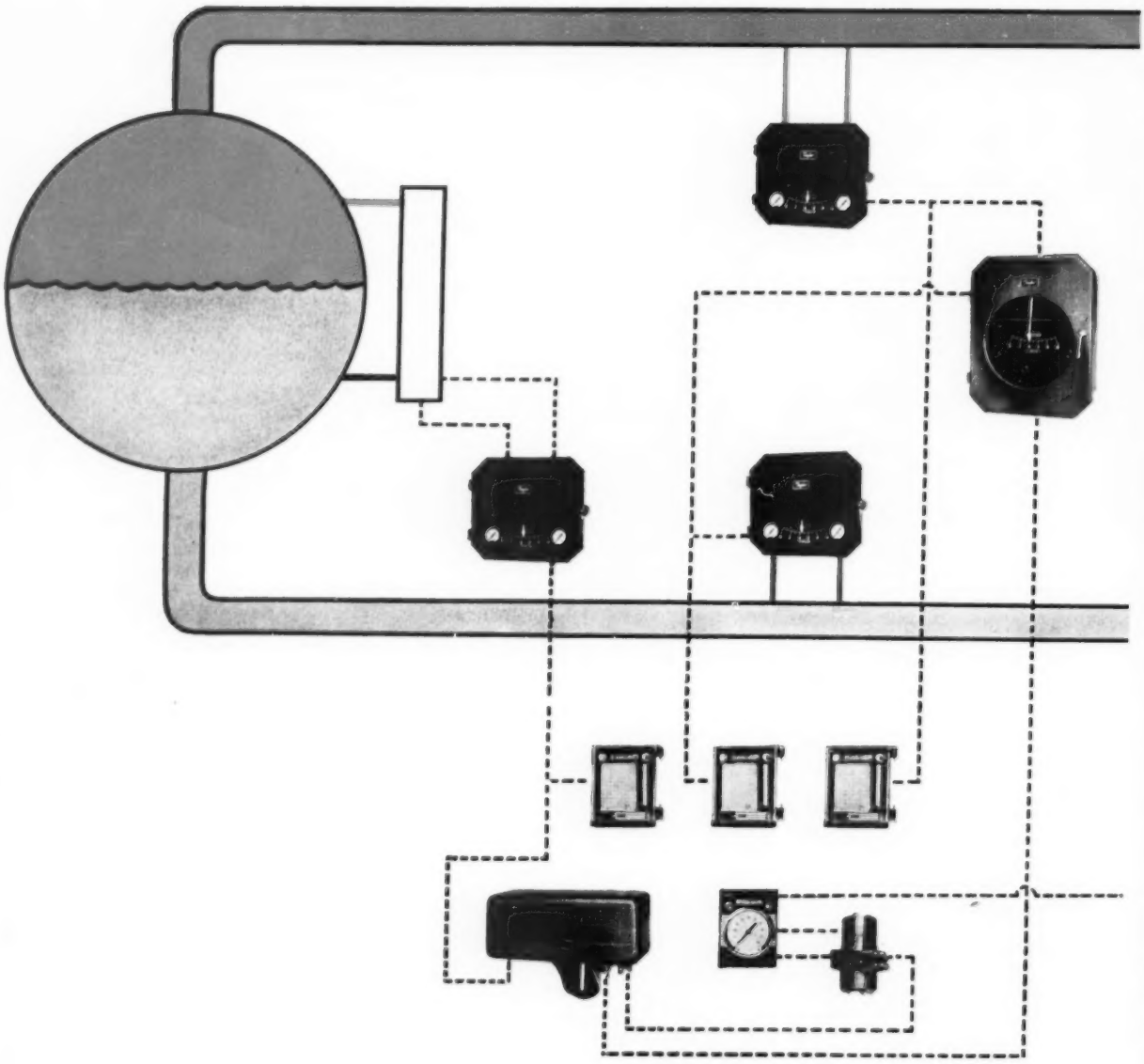
DEPENDABLE VALVES SINCE 1846

Powell Valves

THE WM. POWELL COMPANY • CINCINNATI 22, OHIO

From the oldest

IN THREE-INFLUENCE

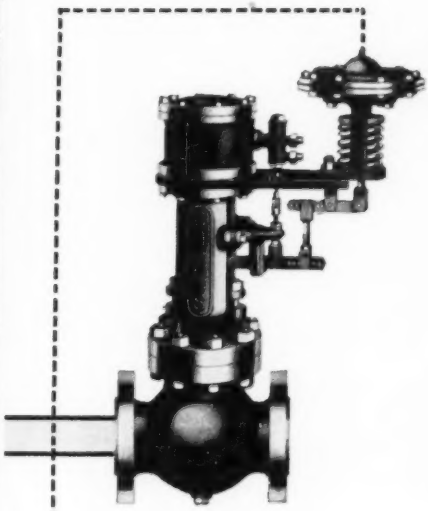


comes the newest

BOILER FEED WATER CONTROL

COPES type 3-L

with instrumentation by Taylor



COPES . . . the *oldest* name in boiler feed water regulation . . . now offers you the *newest* in three-influence feed water control. Combined in the new COPES Type 3-L are . . .

. . . the scientific balance, the characterized ports and the rugged dependability of the COPES control valve

. . . plus the unequalled responsiveness and accuracy of *instrumentation by Taylor*

And Copes-Vulcan assumes undivided responsibility for service, whenever or wherever needed . . . throughout the life of the installation. *Write for Bulletin 1013.* It tells the story of the newest feed water control to come from COPES . . . the oldest name in boiler feed water regulation.

COPES-VULCAN DIVISION

CONTINENTAL FOUNDRY & MACHINE COMPANY

ERIE 4, PENNSYLVANIA

Three-influence mechanically-operated and three-influence electrically-operated regulators are also available.

COPES VULCAN **BOILER CONTROL**

WITH INSTRUMENTATION BY Taylor

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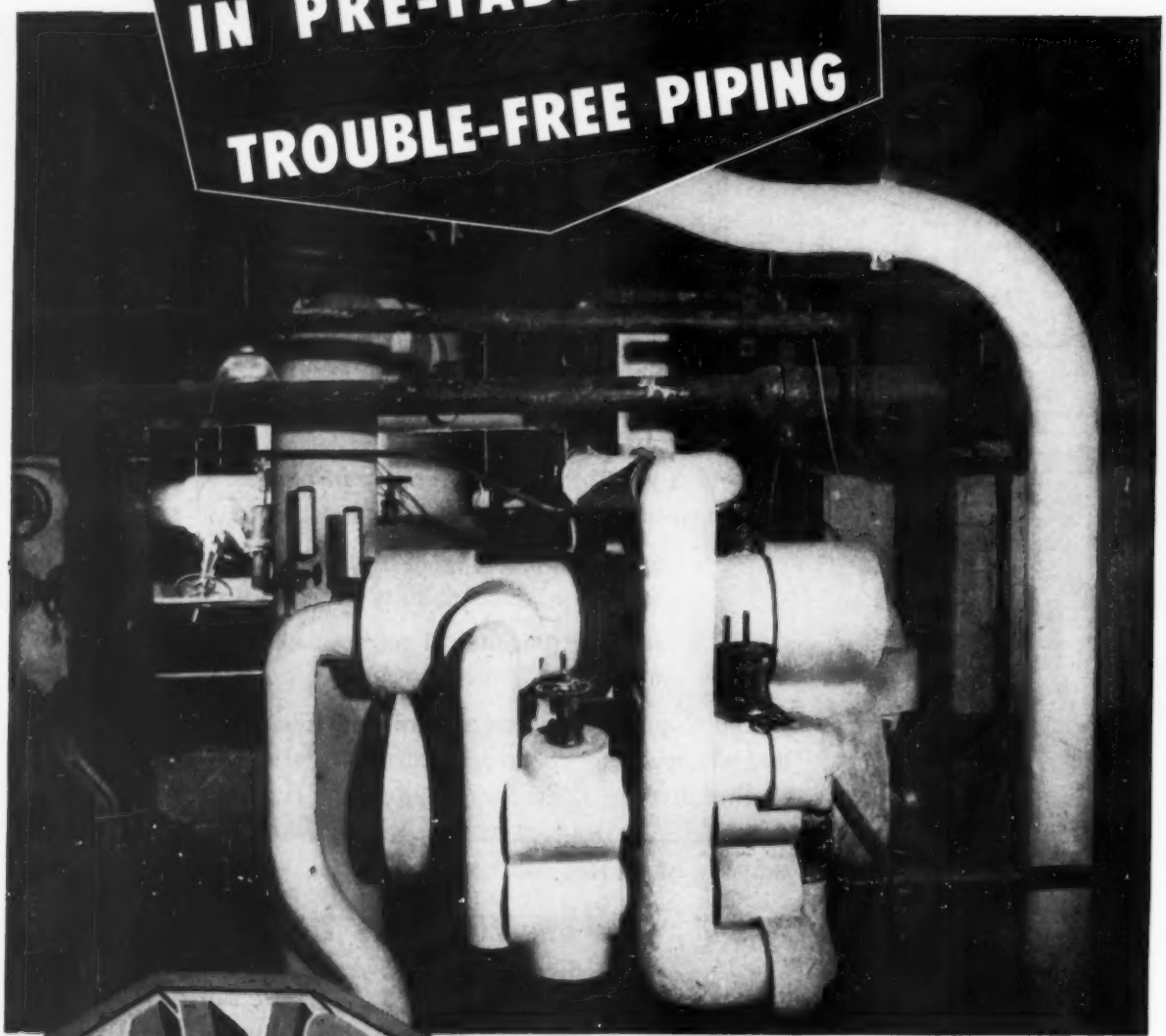
NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

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NONPAREIL
TRADE MARK
Turbine Oil

Here's powerful evidence of the benefits offered by . . .

■ Since 1940, the Indianapolis Power and Light Company has put NONPAREIL Turbine Oil into one new turbine after another. Today, this rapidly growing company has eight big turbines—with 363,000 KW capability—operating on this unique lubricant.

During the 13 years it has been in use, NONPAREIL has provided convincing evidence of its ability to eliminate oil replacements and oil-system cleaning. None of the original fills of NONPAREIL have needed to be replaced. Neutralization numbers have stayed below 0.07 mg. KOH/gm. Oil systems have remained entirely clear.

The lubricant and maintenance savings realized by this utility are just the beginning. Trouble-free lubrication and consequent savings are *assured for the life of the eight turbines* in normal operation. This is based on the written guarantee, given with each fill of NONPAREIL, that this outstanding lubricant will last as long as the turbine, and that its neutralization number will stay below 0.15 mg. KOH/gm.

The Standard Oil lubrication specialist serving your section of the Midwest will be glad to show you lubrication records of NONPAREIL in installations similar to your own. These records cover up to 25 years' continuous operation of individual units on original fills of oil. You can contact this specialist by phoning your local Standard Oil Company, 910 South Michigan Ave., Chicago 80, Illinois.

STANDARD OIL COMPANY

STANDARD *(Indiana)*

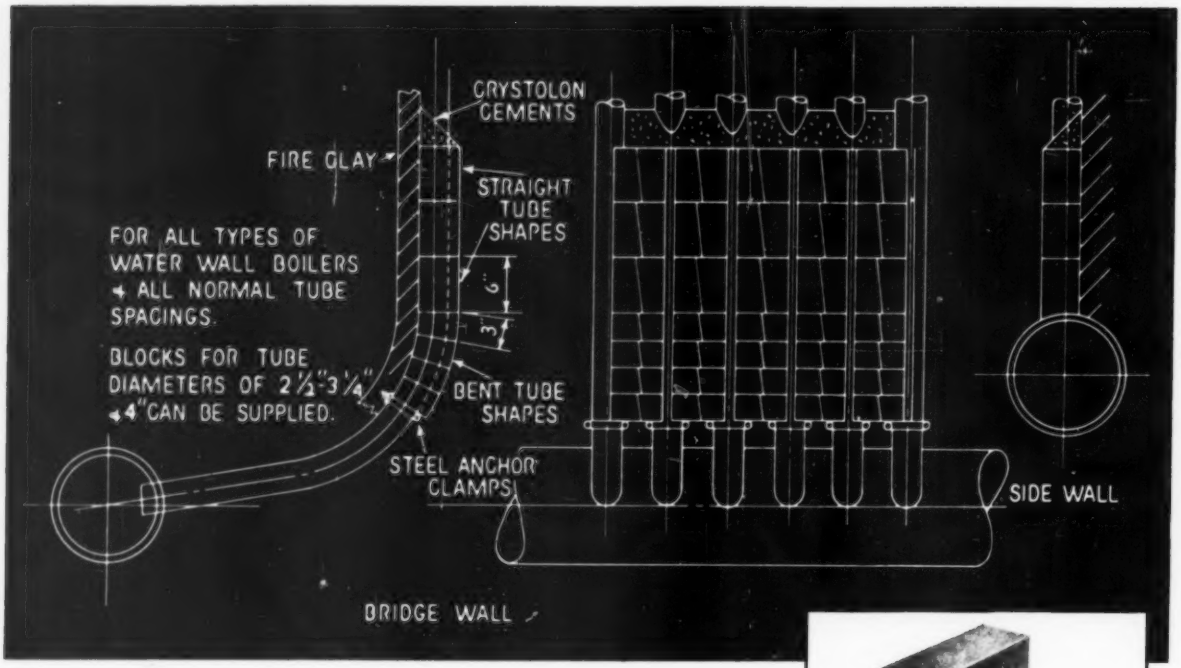
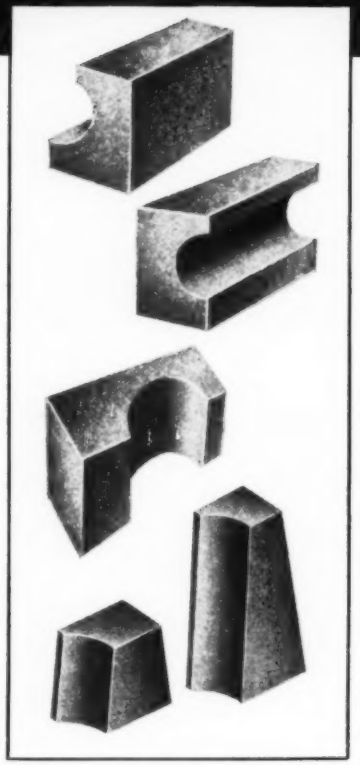


DIAGRAM FOR LONG BOILER LIFE

... and a formula for fewer shutdowns

CRYSTOLON* *Armor Blocks*



The way to get the most out of water tube boilers is to give them CRYSTOLON Armor Block protection.

CRYSTOLON Armor Blocks are made to afford maximum protection to tubes from localized heat generation and flame impingement. They're tapered for secure locking and to maintain intimate contact with the water tubes. They can be replaced readily from the fire side of the boiler.

You'll get these advantages

1. Ability to stand up under high heat (up to 3050°F).
2. Virtually impervious to slag penetration.
3. Practically clinker-proof.
4. Stand up under abrasion caused by the moving bed of stoker-fired furnaces.
5. Installation easy and inexpensive.

And when you need cement, call for Norton CRYSTOLON cement for laying up bricks — and for air-cooled wall construction. The time between shutdowns will be the greatest you have ever experienced.

Bulletin Sent Free

For more information about CRYSTOLON Refractories for Boiler Protection, write for Bulletin 862, NORTON COMPANY, 620 New Bond St., Worcester 6, Massachusetts.

Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Special REFRACTORIES

Making better products... to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

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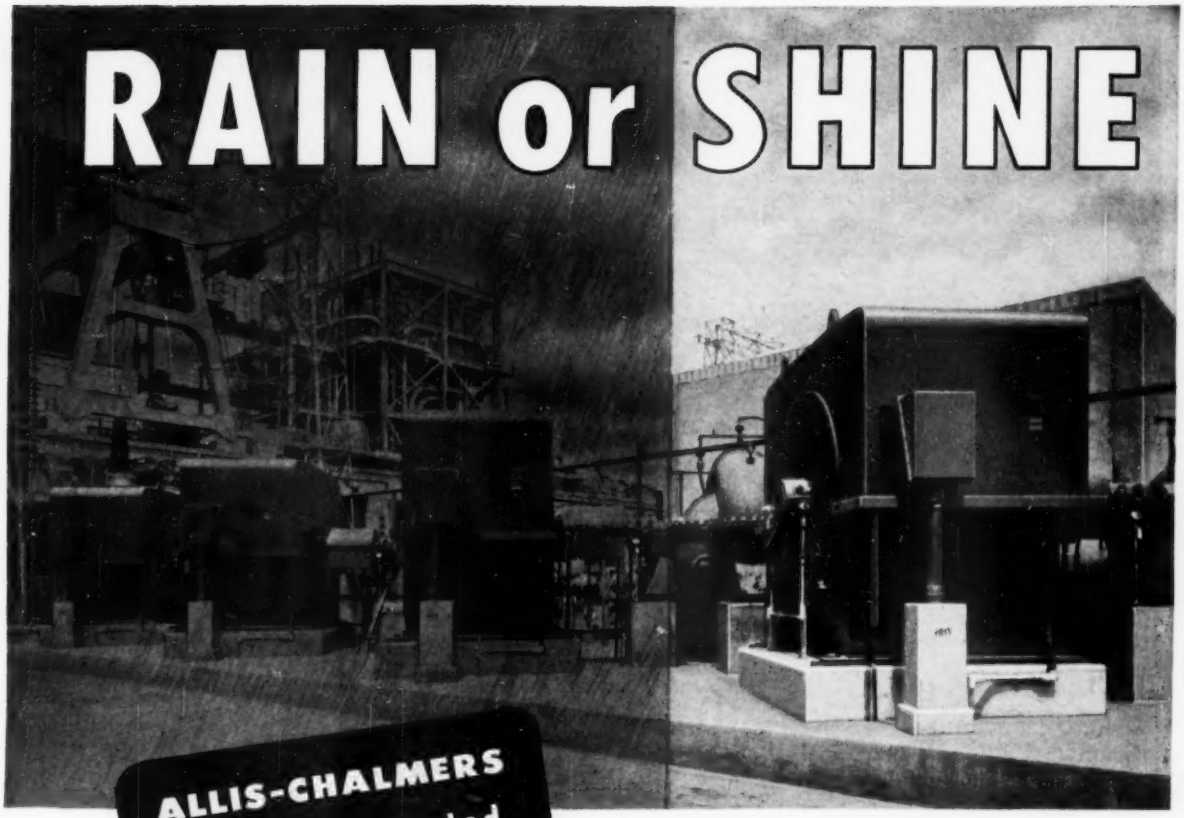
RAIN or SHINE



ALLIS-CHALMERS
Weather-Protected MOTORS

Low-cost outdoor installation plus dependable operation under all weather conditions

Economy plus reliability — regardless of weather conditions — was the combination demanded by Southern California Edison for the circulating water pump motors at the 250,000-kw Etiwanda Steam Station. And that's the combination delivered by the four Allis-Chalmers motors shown above.

Each of these modern weather-protected squirrel-cage motors is rated 900 hp, 4160 volts, 435 rpm. Smaller motors of similar design were supplied by A-C for the station's condensate booster pumps.

Proved by Special Tests

The weather-protected design has been tested under extreme conditions. Running at normal speed and voltage, motors of this type were deluged with water at rates up to 40 inches per hour — driven by winds up to 75 miles per hour. This was done repeatedly from all angles, but on inspection no moisture was detected on the windings. And other tests checked effectiveness in keeping out wind-driven fine sand — a serious threat at this west coast installation.

Movie and Bulletin Available

See how A-C test-proved these motors. Ask your A-C representative to show you the 12-minute movie *The Sky is the Roof*. Or write for Bulletin 05B7874. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4176

ALLIS-CHALMERS

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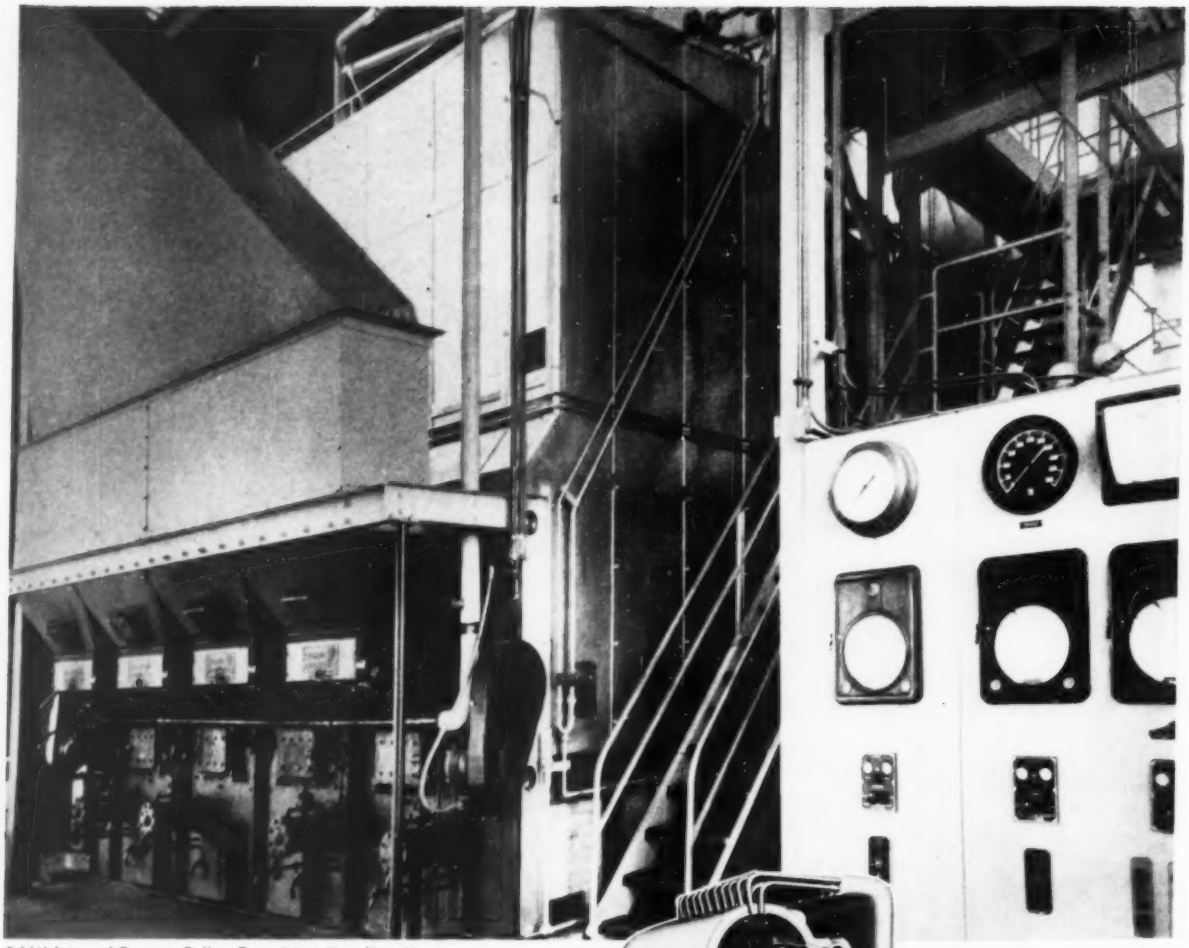
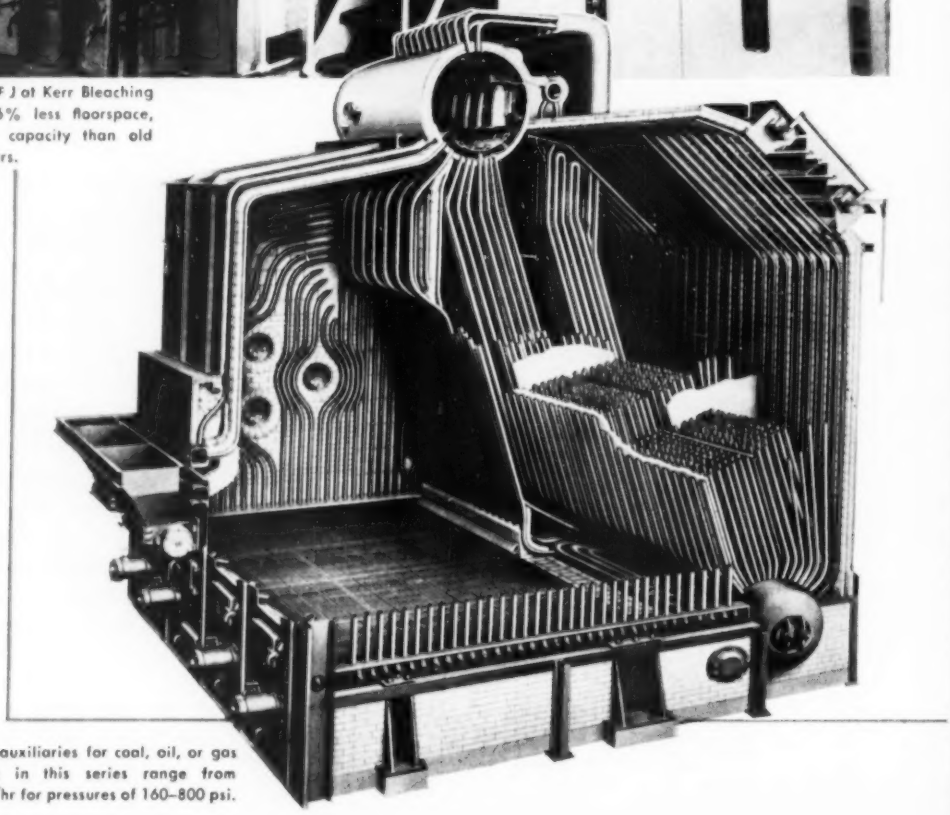


B&W Integral-Furnace Boiler, Type F J at Kerr Bleaching and Finishing Works, required 46% less floorspace, yet delivered 50% higher steam capacity than old installation of nine separate boilers.

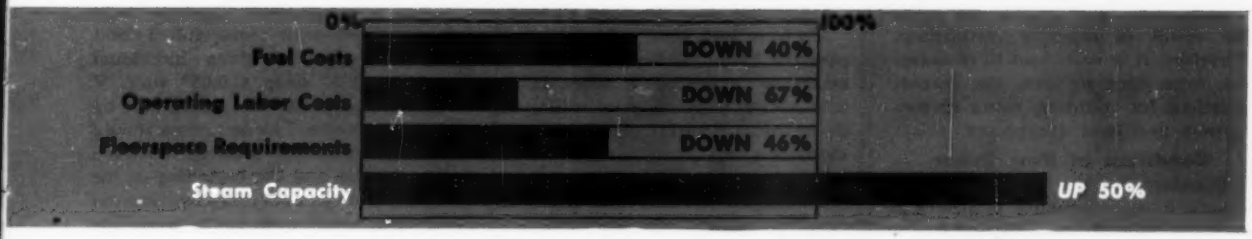


Type F J unit and auxiliaries for coal, oil, or gas firing. Capacities in this series range from 30,000–70,000 lb/hr for pressures of 160–800 psi.

G-486

WHAT HAPPENED...

When 1 New B&W Integral-Furnace Boiler Replaced 9 Old Boilers...



... at

KERR BLEACHING and FINISHING WORKS

When this Concord, N. C. Company found their nine old boilers were not yielding adequate steam to maintain steady production, they commissioned A. G. Odell, Jr. and Associates to design a building to house a brand new steam plant. And to insure a constant and dependable process steam supply under demands that varied from 28,000 to 73,000 pounds per hour . . . with swings as wide as 16,000 pounds per hour . . . Kerr engineers selected a single B&W Integral-Furnace Boiler, Type FJ, 250 psi, 60,000 lb/hr continuous and 70,000 lb/hr peak load on coal, oil, or gas.

Performance over the three-year period since the change from "Nine to One" more than substantiated the confidence placed in this B&W unit . . . and, just as important, contributed far-reaching economies. Fuel, payroll and maintenance charges were cut sharply . . . savings on fuel alone amount to more than $90,000 a year. Valuable floorspace was released for additional production facilities. *And* . . . with a reliable, ample steam supply available, orders are being scheduled more accurately, while production quality and quantity have reached new highs.

Complete satisfaction with the continuing performance of this unit—even under load conditions exceeding design specifications—was indicated when this company recently installed another B&W Integral-Furnace Boiler, Type FJ. To quote Mr. W. Hunt Fisher, Plant Engineer of Kerr Bleaching, "On the basis of what our present unit has done for us, I am confident that we could not have made a wiser choice for our new one."

To the hundreds of other users of B&W Integral-Furnace Boilers, their economical installation, maintenance, and operation are an old story. (Units producing a total of over 200,000,000 pounds of steam per hour are in service and on order for almost every variety of industry, plant or institution.) If *you* have problems in steam supply for processing, power, or heating, B&W's more than 70 years' experience in boiler construction and application will interest both your plant engineers and cost accountants. The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.

COST SAVING FEATURES

of B&W Integral-Furnace Boilers for Steam Requirements from 2,800 to 350,000 Lb. Per Hr.

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

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BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Reduce Premature Tube Failure With Proper Installation Methods

Premature tube failures are often the result of improper installation. Therefore, it is important to re-examine, from time to time, the current practices for installing tubes in condensers and heat exchangers.

Condition of New Tubes

Standard practice these days is to supply brass, aluminum bronze, and cupro nickel tubes sufficiently annealed for complete recrystallization but with fairly small and uniform grain size so that tubes are not too soft for handling. It is not necessary to end-anneal such tubes when they are to be rolled into the tube sheet. Copper tubes usually are made with a 10% reduction (moderately hard), which also can be handled more readily without denting, etc., and can be rolled into the tube sheet without end-annealing.

Installing and Expanding

The inlet ends of roller expanded tubes, as in the case of packed tubes, must be firmly and rigidly held in the tube sheet. If no expansion joint between the shell and a tube sheet has been provided, the discharge ends of the tubes are installed with a packed joint—a combination fibre and metallic packing being generally preferred. When there is an expansion joint, or the tubes are short or the temperature change in service is slight, the tubes can be roller expanded at both ends.

No provision for thermal expansion and contraction is made in most short condensers and heat exchangers. Roller expanding tubes in smooth holes generally is not recommended, particularly where long tubes are used and where the operating temperature is relatively high, as there is no assurance that the tubes will be tight when installed, nor that they will stay tight.

In general, a 5% to 10% reduction in tube wall thickness will give a tight tube in a serrated hole. On the other hand, reduction in wall thickness of 15% or over may cause leaking, split or flaked tubes.

Tightness and Holding Power

To have each tube tight enough to pass the hydraulic test, it is not necessary to "overexpand" tubes in the tube sheet. Expanding or rolling reduces the tube wall thickness but overexpanding may cause corrugations and leaks.

Overexpansion may also leave unrelieved stresses which in time can cause failure by season cracking, which appears as circumferential cracks at or a short distance beyond the tube sheet. "Flaking" of the inside of the expanded section of the tube is caused by overworking the metal. This condition is aggravated by improper lubrication of the expanding tools or by worn rollers and mandrel.

Recommended Diameter of Flared Inlet of Holes in Tube Sheets

O.D. of tube	A	B	C
½″	0.60″	0.38″	0.21″
⅝″	0.75″	0.47″	0.26″
¾″	0.90″	0.56″	0.31″
⅞″	1.05″	0.67″	0.36″
1″	1.20″	0.75″	0.42″

Holes for tubes should be drilled and reamed no more than 0.007″ to 0.010″ larger than the O.D. of the tubes. For critical conditions even smaller reamed holes may be required. The inside end of these holes should be chamfered 1/16″ x 45°. Figure 1 and table give the recommended dimensions of the holes for inlet end

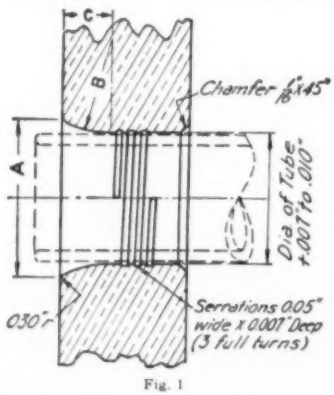

Fig. 1

bell-mouth tube sheets with a bell 20% larger in diameter than the O.D. of the tubes. The preparation of a smooth belled end is done in the interest of keeping turbulence and inlet end corrosion at a minimum. The holes may be serrated with three full helical turns, or two or three individual grooves .005″ deep x 0.05″ wide. V thread serrations are preferred by some engineers. The serrations should be approximately midway between the chamfer and the beginning of the bell. Serrations materially increase the holding power and tightness of the tubes. Figure 2 shows the recommend-

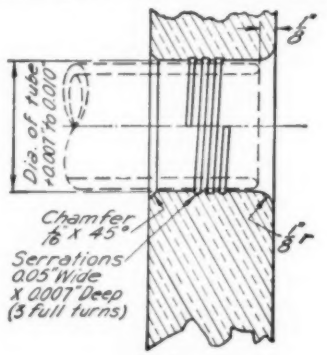

Fig. 2

ed dimensions of the holes in discharge end tube sheets for expanded tubes. The dimensions of holes for packed tubes depend on the type and dimensions of the packing.

Recommended practices for installing condenser and heat exchanger tubes by roller expansion and ferrules are covered in our tube handbook.

Write for Handbook

Our 156-page "Condenser and Heat Exchanger Tube Handbook" contains a detailed discussion of modern installation procedures. It also provides information about Duplex Tubing, condenser tube alloys, various types of corrosion encountered in condenser and heat exchanger tubes, and many suggestions for increasing tube life. Write for your copy.

Technical Service

Bridgeport's Technical Laboratory will be glad to cooperate with engineers, and try to help them arrive at practical, cost-saving solutions to their specific tube problems. (568)

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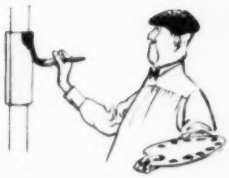

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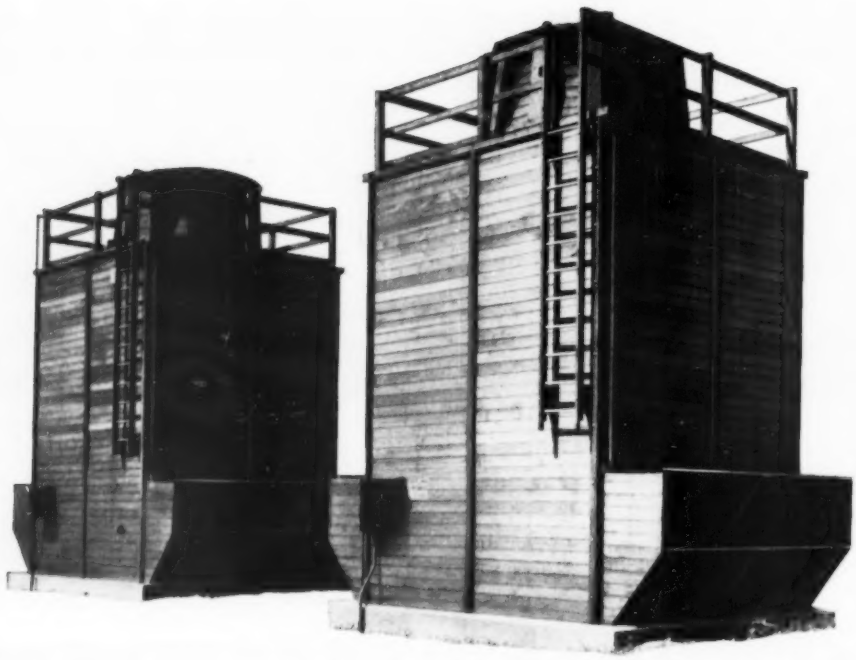

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In the past decade Conoflow has made many contributions to the field of Final Control Elements by the development of pneumatic operators for throttling control service. Today, the Conoflow LB Control Valve represents one of the greatest forward steps in control valve design. We believe it heralds a new era of original thinking in keeping with the modern standards of the completely automatic plant.

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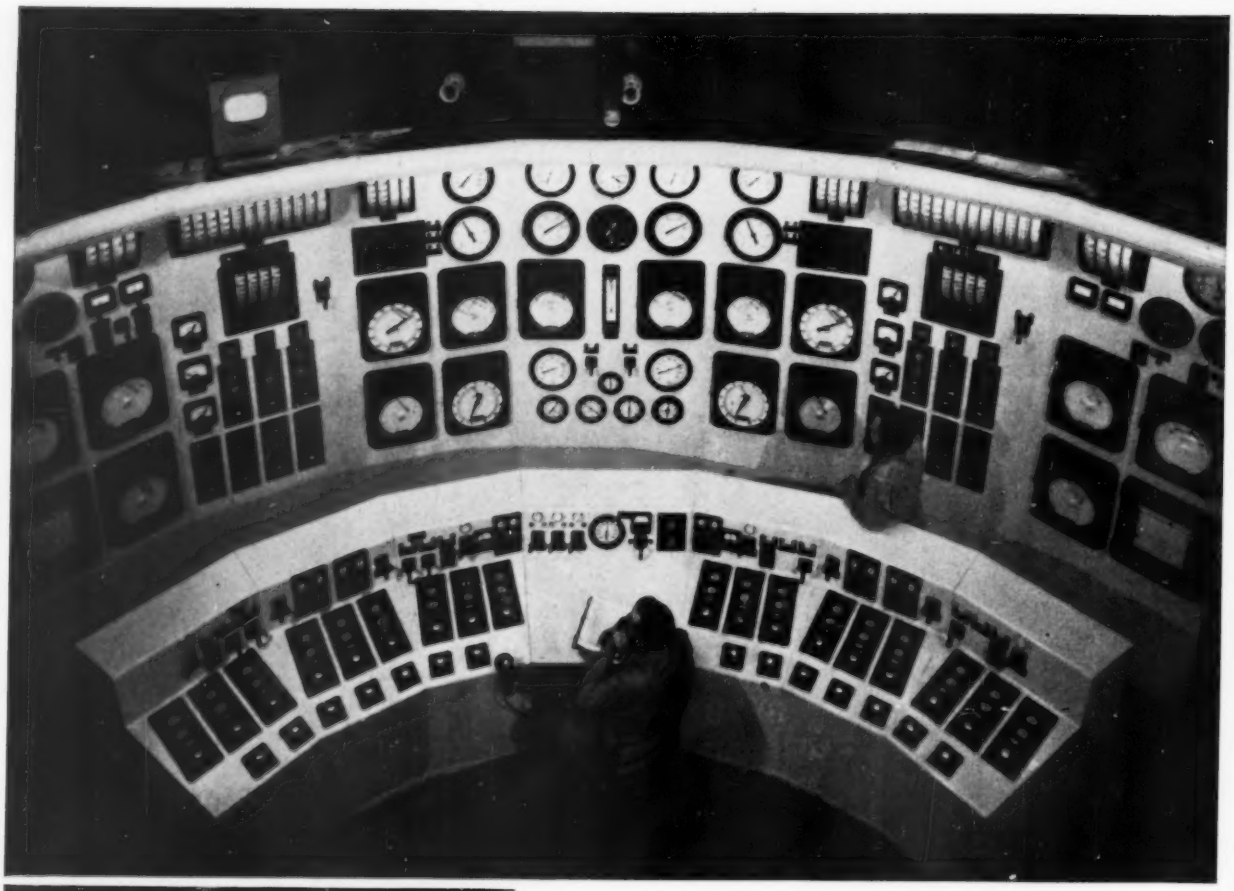

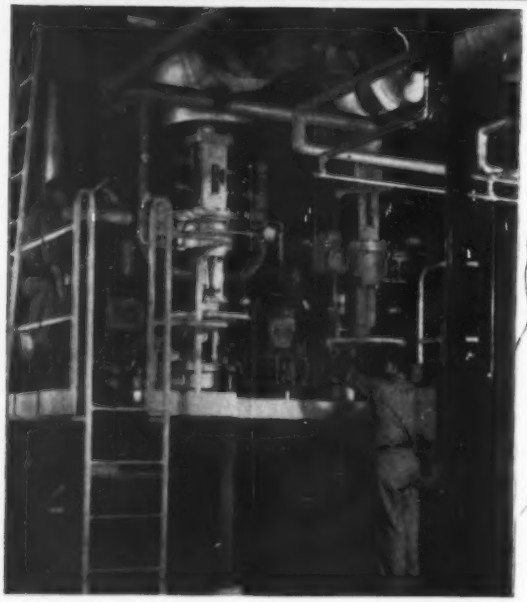

PRESSURE REDUCING STATIONS in the plant are controlled automatically or manually, as desired. The two stations shown include Republic pressure reducing valves which are controlled from a master pressure regulator. Desuperheater stations, controls for feed-water pumps and discharge valves, and flow meters were also furnished by Republic for this modern power plant.

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Two 400,000 lbs./hr. boilers fired by four cyclone furnaces are checked and controlled from this central control point. Republic sub-panels on the control bench board are provided for transferring between automatic and manual operation. Also included are Republic biasing sub-panels for adjusting coal-air ratio, primary-secondary air, cyclone ratio and boiler rating.

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This cyclone-fired plant serves as *additional proof* that Republic combustion control systems can be adapted for *any* type of fuel firing. There are Republic combustion control systems for all sizes and types of boilers, all arrangements of draft equipment and for all load conditions. There's an experienced engineering staff* to help you get the combustion control system that best fits *your* needs.

For full information, write for Data Book S-21 or contact your nearby Republic field engineer.

*For more than 37 years, Republic has *specialized* in the design and manufacture of combustion control systems for all sizes of power generating stations.

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ELECTRICAL

101 Heavy-Duty Switchgear — Station-type cubicle switchgear — primarily intended for heavy-duty service in electric utility generating and distribution substations — is described in 24-pp Booklet B-5670. This switchgear consists of a large-capacity heavy-duty power circuit breaker, isolating disconnecting switches, connections and bus, all enclosed in a metal cubicle with circuits and individual phases segregated. Photos and drawings show details of construction and operation. Westinghouse Electric Corp.

102 D-C Motors and Generators — Bulletin 1450, 16 pp, covers ½- to 300-hp motors and ¾- to 250 kw generators. Photos and cutaway drawings show details of construction, available enclosures for different operating conditions, applications, and special d-c designs. Motor-generator sets converting a-c to d-c in industrial service are described. Text and diagrams cover d-c electrical characteristics and show features, advantages, and application of shunt, series, and compound motors. The Louis Allis Co.

103 Motor Starters — Features of manufacturer's Type H starters for squirrel-cage, synchronous, wound rotor and multi-speed motors in ratings from 2200 to 5000 v are described in 12-pp Bulletin 14B6410B. Air and oil contactors available with these starters are explained as to operation. Short circuit, overload, time relay undervoltage and pullout protection features are described, and schematic wiring diagrams of control methods are included. Allis-Chalmers Mfg. Co.

104 Oil-Immersed Starters — Design and maintenance of oil immersed starters are described in Bulletin GEA-3541, 8 pp. More than 20 photos and cutaways are used to illustrate various features. Also included are ratings and dimension diagrams. General Electric Co.

105 Circuit Breaker Panelboard — Bulletin B-5644, 8 pp, describes and illustrates features of a circuit breaker panelboard. Design details of the Quicklag breaker, such as De-ion arc extinction and positive trip action, are described. Westinghouse Electric Corp.

INSTRUMENTS AND CONTROLS

106 Testing Instrument Guide — Bulletin GEA-5469B, 16 pp, provides buyer's information on volt-ammeters, wattmeters, and power-factor meters all of the hook-on type; also portable recorders, voltmeters and ammeters, phase-sequence indicators, hand pyrometers, surface roughness scales, insulation-resistance meters, and others. Application data included. General Electric Co.

107 Meters and Controls — Bulletin 17-E, 16 pp, describes company's line of instruments used in metering and automatically controlling process variables. Ranges, basic specifications, and detailed literature references on instruments are offered. Bailey Meter Co.

108 Dial Thermometers — Sixteen-pp Bulletin 467, on dial thermometers for long distance measurement emphasizes the variety of ranges, and the bulbs, tubing and accessories available. Provides full data on temperature indicators of the vapor pressure and gas pressure types. A separate section gives details of construction. Both Centigrade and Fahrenheit ranges are listed. The Foxboro Co.

109 720-Cycle Control Systems — Use of company's systems for off-peak control of water-heating loads is announced in Bulletin GEC-931, 28 pp. Contains information on station equipment, coupling equipment, and load switches. Features and advantages of the equipment — load switches, station equipment, load-control units, converters, couplings — are listed. General Electric Co.

110 Electronic Recorder — The Tektolog, an electronic recorder for any purpose requiring graphic recording of a physical measurement made in terms of electrical energy, is described in illustrated Bulletin F-103, 8 pp. Explains how recorder operates, tells features. Both portable and industrial type instruments are pictured, dimensions and specifications given. Fielden Instrument Div., Robertshaw-Fulton Controls Co.

111 Miniature Indicator — Construction, installation, and design features of a remote miniature indicator are described in Bulletin 55-10, 12 pp. Shows construction of the bellows spring assembly. Fischer & Porter Co.

112 On Watthour Meter Sockets — Twenty-pp Bulletin GEA-5878 is designed to aid in selecting watthour meter sockets for all applications. This reference publication also covers installation and connection of watthour meters. General Electric Co.

MECHANICAL POWER TRANSMISSION

113 Speed Reducers — Sixteen-pp Booklet B-5646, covering a complete line of speed reducers, discusses features of the equipment, manufacturing techniques, and applications. Standard ratios available for all types of speed reducers are given. Special units developed for right-angle drives, and in-line drives are discussed. Westinghouse Electric Corp.

114 Fluid Drive — Of value to power engineers interested in obtaining adjustable speed operation in a range from 100 to 2500 hp is 24-pp Bulletin 9319, illustrated in color. Covers company's Type VS, Class 4 Gyrol fluid drive, explaining its principle of operation and illustrating its use with forced and induced draft fans, centrifugal compressor and reciprocating pump. American Blower Corp.

115 Belt-Center Calculator — Belt-center selection for fans, and compressors, determination of horizontal distances between shaft centers, and checking equipment clearances are easily calculated with

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101	102	103	104	105	106
107	108	109	110	111	112
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119	120	121	122	123	124
125	126	127	128	129	130
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237	238	239	240	241	242	243	244	245	246	247	248
249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272
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WATER CONDITIONING

116 Water Sampling — Leaflet 28x-7969 gives information on factors involved in obtaining useful samples required for proper control of water conditions in a power house. Tells which samples are important, when they should be taken, where to obtain them, and how they should be drawn. Allis-Chalmers Mfg. Co.

117 Mixed-Bed Demineralizers — How a mixed-bed demineralizer operates to produce high-purity demineralized water is explained in Bulletin 126. Describes and pictures compact equipment utilized, stresses its long service. Also discusses simplified regeneration. Barnstead Still & Sterilizer Co.

118 Automatic pH Control — Technical Bulletin 55, recently reissued, is a 7-pp illustrated article on automatic pH control in water and industrialwaste treatment. Outlines several typical systems of such control in boiler feedwater treatment, using air- and motor-operated valves as well as controlled volume pumps. Milton Roy Co.

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HEATERS, HEATING SYSTEMS

119 Why Unit Heaters — The versatile nature of the modern unit heater is shown in Bulletin 14, 12 pp. Presents a wide scope of commercial, institutional and industrial heating installations. Unusual spot-heating applications are also included. Displays solutions to heating problems in which comfort, economy and floor saving have been accomplished. Industrial Unit Heater Association.

120 For Better Heating Systems — How to get heat out of that last radiator, have warmer floors, stop heating system noises and stretch the capacity of the burner, boiler and radiation are told in three new bulletins. No. E-353 tells how company's Weather-Flo operates, and results attained. No. F-453 describes its application to hot water systems. No. H-653 describes its application to warm air systems. Automatic Devices Co., Inc.

BOILERS, GENERATORS AND AUXILIARIES

121 Water-Tube Package Boilers — This bulletin describes and illustrates company's Type H water tube package units. Advantages of the boiler are listed. Also included are dimension drawings and a table of capacities, sizes and weights for ten standard sizes from 8000 to 30,000 lb of steam per hour. The Bigelow Co.

122 Steam Generators — Bulletin G.B.-153, 20 pp, covers company's diversified line of steam generators and allied equipment. Described are eight basic arrangements of two, three and four drum steam generators furnished to meet a wide range of loads, pressures and temperatures for power, process and space heating; heat recovery units, including fire tube and water tube boilers, plain tube and cast iron extended surface economizers; other equipment. Union Iron Works.

123 Refinery Process Burner — Bulletin 703-A describes construction features of company's combination gas and oil burners and vertically or horizontally fired premix gas burners for process furnaces. Stresses wide range of fuels usable. Peabody Engineering Corp.

For Increased Safety

124 Flame Failure Protection — "Guarding Your Property Against Flame Failure Explosions" is a complete but non-technical explanation of the explosion danger inherent in fuel burning equipment. Shows how to make a safety survey to determine whether a fuel burner is adequately protected against explosion. Combustion Control Corp.

125 High-Voltage Handling Tools — A line of handling tools designed specifically for high-voltage switches, fuses, and cutouts is described in 12-pp Catalog Section 823. Some of the tools covered perform a single handling function, several serve multiple purposes. Covers socket-, spiral-, prong-, clamp- and other fittings. Also lists universal pole and pole extension converters. S & C Electric Co.

126 Engine Exhaust Purifier — A catalytic device for removing CO, fumes and odors from gasoline-powered equipment is illustrated and described in this bulletin. Tells how this exhaust permits safe indoor operation of gasoline engines, even in places previously considered impractical. Explains how, by chemically burning out harmful unconsumed gases, it reduces carbon monoxide to a safe level and helps purify air. Oxy-Catalyst, Inc.

VALVES, TRAPS AND PIPING ACCESSORIES

127 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows replacement parts and accessories for these valves and gives prices and dimensions. The William Powell Co.

128 Pressure Reducing Valve — Bulletin 228, 8 pp, describes and pictures a pilot-operated pressure reducing valve designed for automatic control of reduced pressure required in steam service. Gives advantages of the valve, illustrates method of installation and explains its operation. McAlear Mfg. Co.

129 Float and Lever Valves — Catalog 107, 16 pp, gives information on valve selection. Applications, operation and construction features of float, and lever valves, tank level control, water control valves, cylinder or diaphragm-actuated control valves are given. Cutaways, dimensional drawings and tables are included. Schade Valve Mfg. Co.

(*Continued on page 117*)

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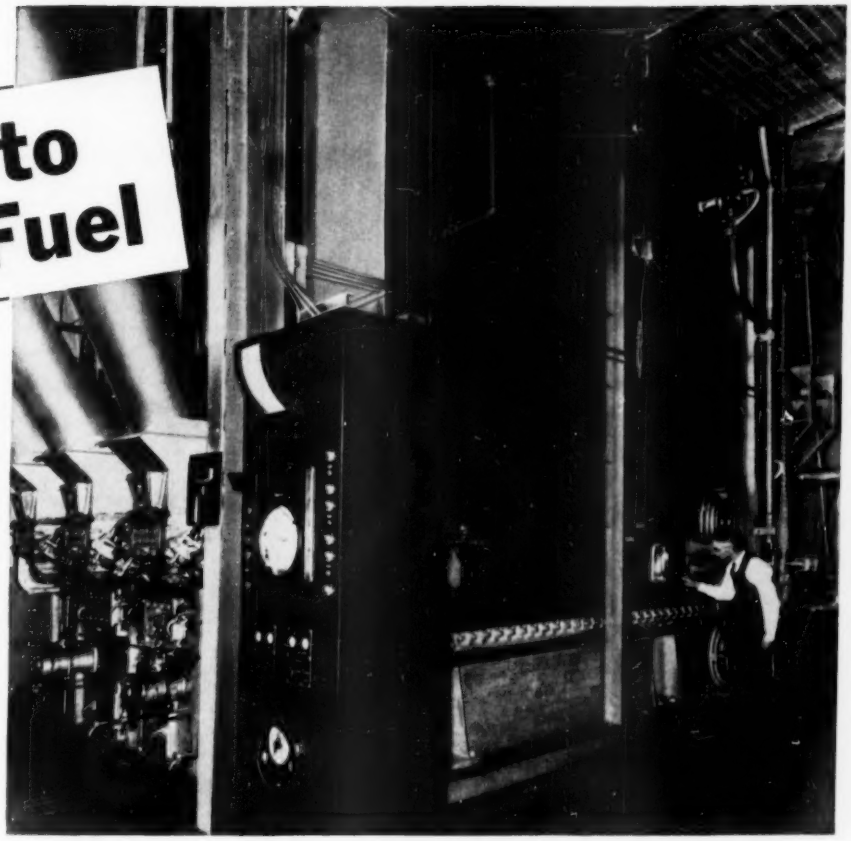

Fuel savings of 15% have resulted from steam plant modernization at General Mills, Inc., Buffalo, N. Y. The program included this installation of Bailey Meter Control on a 45,000 lb per hr, 170 psi spreader stoker-fired boiler.

● The heat energy you get from a unit of fuel depends on the performance of your steam plant equipment. And that's where Bailey controls can help. With a Bailey-engineered control system you can count on a higher output of available energy per unit of fuel. Here's why:

1. Suitable Equipment

When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

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Your local Bailey Engineer brings you seasoned engineering experience based on thousands of successful installations involving problems in measurement, combustion, and automatic control.

3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record.

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TYPICAL RILEY 1,250,000 lbs./hr. REHEAT UNIT

Capacity—1,250,000 lbs. hr.
Design Pressure—2125 psig.
Superheater Outlet Pressure—1925 psig.
Steam Temperature—1005°F.
Reheater Capacity—1,148,000 lbs. hr.
Reheater Outlet Pressure—470 psig.
Reheater Temperature—1005°F.
Efficiency Gas Firing—83.7%
Pressurized Furnace
Fired by Gas. Oil Standby
Designed for future conversion to Lignite firing.

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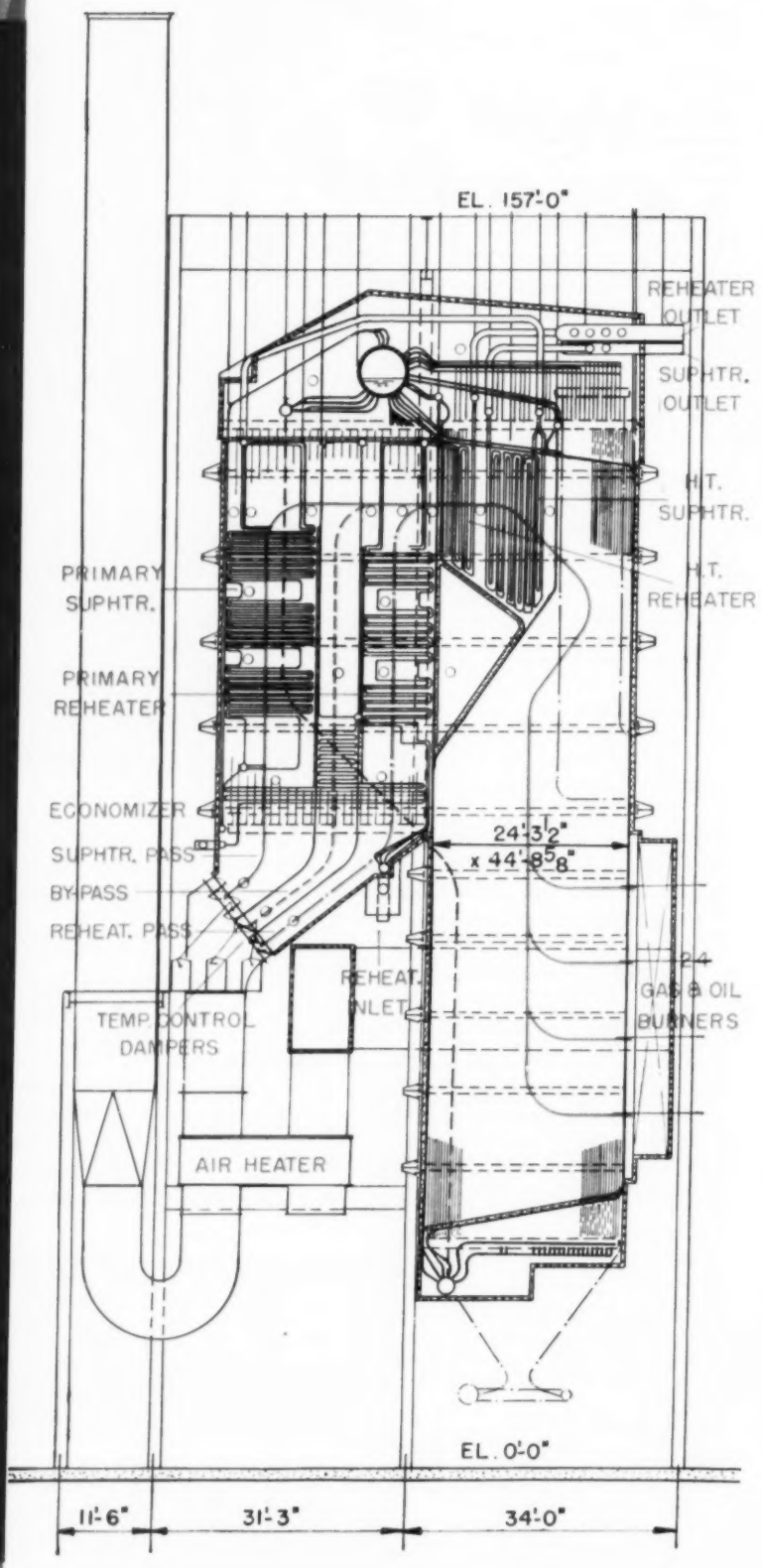
You, too, can rely on Riley experience and know-how when considering steam generation and fuel burning equipment.



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  2075 psig. 1005°F.
  1005° Reheat

- **DEPT. OF WATER & POWER**
  City of Los Angeles, Cal.
  1,200,000 lbs./hr.
  2075 psig. 1000°F.
  1000° Reheat

- **TEXAS ELECTRIC SERVICE CO.**
  1,250,000 lbs./hr.
  2075 psig. 1005°F.
  1005° Reheat

- **LOUISIANA POWER & LIGHT CO.**
  1,000,000 lbs./hr.
  1725 psig. 1005°F.
  1005° Reheat

- **PUBLIC SERVICE CO. OF INDIANA, INC.**
  884,000 lbs./hr.
  2050 psig. 1005°F.
  1005° Reheat

- **UTAH POWER & LIGHT CO.**
  575,000 lbs./hr.
  1700 psig. 1000°F.
  1000° Reheat

These are but a few of the big Riley installations that are being ordered by power companies in State after State across the country. The Houston Lighting & Power Company, one of the large Southwest public utilities, has recently ordered two of the big 1,250,000 pounds per hour Riley Reheat Units. These will be their tenth and eleventh Riley units, nine others having been installed during the past fifteen years. These Riley units will increase the Houston Company's steam capacity to over 7,000,000 pounds per hour Both the Texas Electric Service Company and the Dallas Power & Light Company will also increase their power generating facilities with similar units of 1,250,000 pounds per hour capacity . . . conclusive evidence that Riley enjoys the confidence of increasing numbers of big, expansion-minded power companies.

TRADE MARK Rx REGISTERED

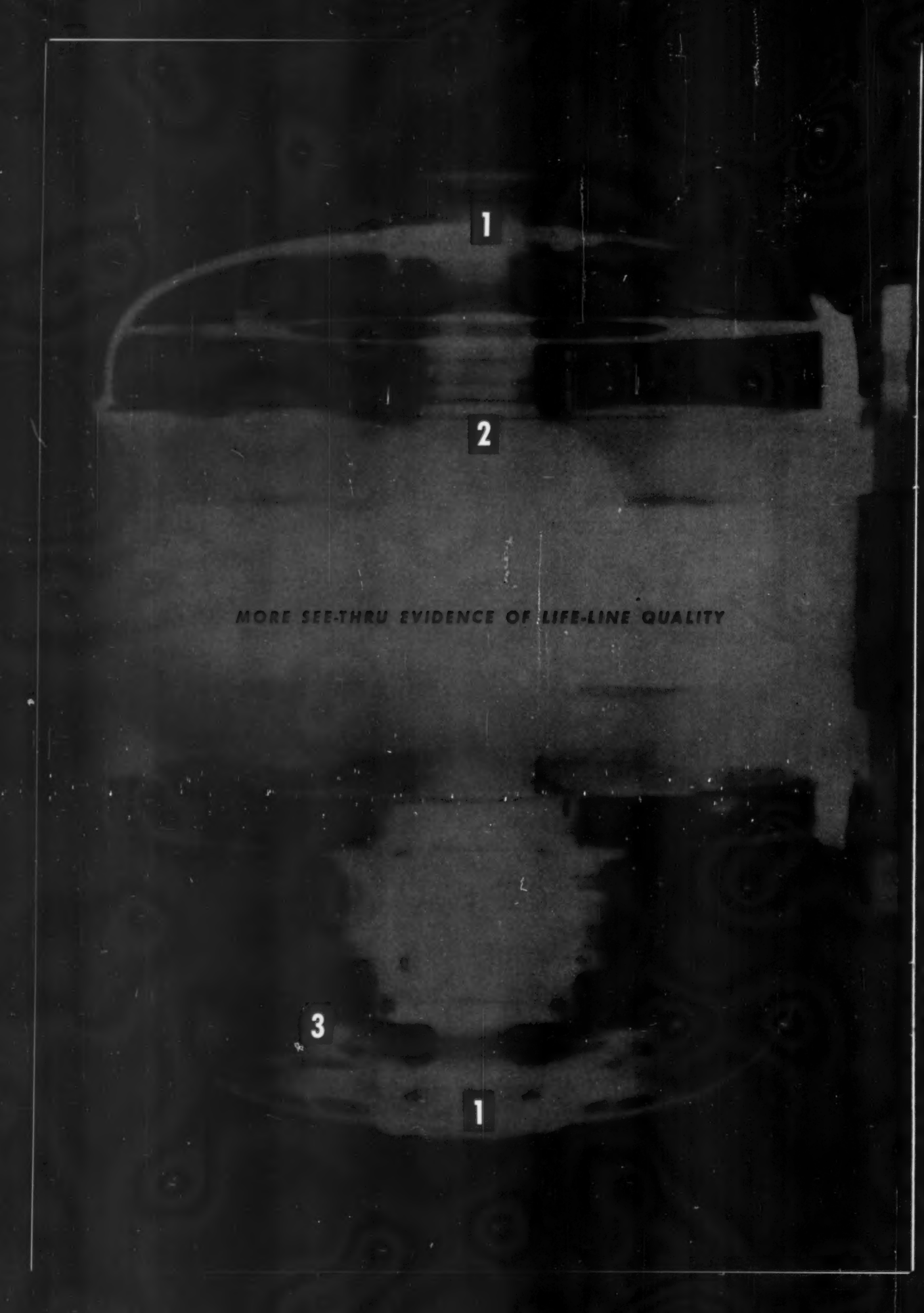
RILEY
STOKER CORPORATION

WORCESTER, MASS.
Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, Portland, Seattle

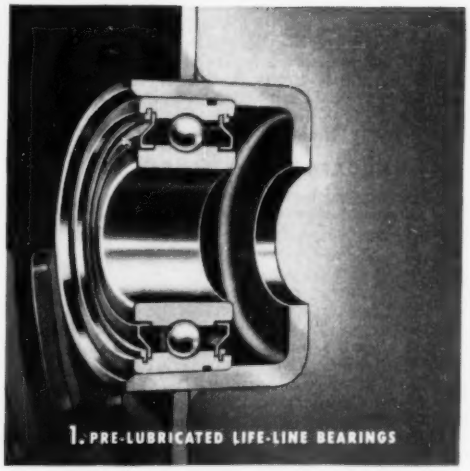
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

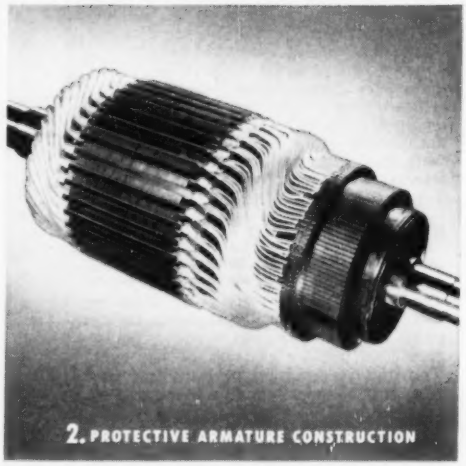
For more data circle 526 on Post Card


1
2
MORE SEE-THRU EVIDENCE OF LIFE-LINE QUALITY
3
1

X-Ray camera probes *Life-Line* d-c motor



1. PRE-LUBRICATED LIFE-LINE BEARINGS



2. PROTECTIVE ARMATURE CONSTRUCTION

3. CAST BRASS BRUSH-HOLDERS

Here, for the first time, you actually look through the muscle and sinew of a ¾-hp Westinghouse d-c motor. Note the Life-Line* construction features that assure dependability in the SK motor line.

Starting with the all-steel frame and feet, you can see the sturdy protection that is built into each SK motor. Angled steel-plate feet are welded right to the frame offering plenty of resistance to shock or vibration.

Pre-lubricated Life-Line bearings—Looking at inset picture #1, you see in greater detail why SK motors never need greasing. This Life-Line pre-lubricated bearing is factory packed with just the right amount of grease . . . specially compounded to inhibit oxidation or deterioration. A double seal on the Life-Line bearing is positive assurance that grease stays in . . . dust and dirt stay out.

Protective armature construction—Inset #2 pictures the SK armature's compact windings of special Tufvar® insulated wire. This enamel insulation provides a tougher, more flexible finish to stand up to heat, moisture or corrosion.

After construction, each SK armature is dynamically balanced to .001″, reducing vibration to a minimum.

Cast brass brushholders — Move your eye to inset #3 and you see at a glance the ease of adjusting or replacing brushholders. The entire assembly is made of cast brass for maximum corrosion resistance. Notice too, that no lever arm is used. A flat steel spring bears directly on the carbon brush. Thus, there are no bearing parts to bind, wear out or jam. Proper brush tension is always maintained.

Investigate these dependable d-c motors by calling your local Westinghouse representative, or write for Bulletin B4595, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21749

*Trade-Mark

YOU CAN BE SURE...IF IT'S

Westinghouse

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 35 and 117 for your request. Just circle the numbers of the items you'd like to know more about

1 — PACKAGED PREHEATER

For small and medium capacity boilers — can be erected quickly

One of manufacturer's packaged Ljungstrom units for preheating combustion air, this preheater is said to require only 100 to 250 manhours for erection. It is designed for non-stoker fired boilers in the 30,000 to 125,000 lb of steam per hour capacity range and is intended primarily for boilers with operating pressures of 300 psi or more.

These preheaters operate on the continuous regenerative counter-flow principle. Flue gases from the boiler pass over heat accumulating plates which are carried through the gas stream by a slowly-revolving rotor. Having picked up waste heat from the exit gases, the plates then pass through the stream of incoming combustion air and give up this otherwise waste heat. Preheating of combustion air with waste heat effects fuel economies, it is stated, and leads to higher steam generating capacities. Air Preheater Corp.

2 — BYPASS SWITCH

For use with voltage regulators on 7.5-, 15-, 23-kv distribution circuits

In isolating or reinserting a voltage regulator, this switch does the work of three, company says. After the lineman opens the switch with a hookstick, the switch contacts operate in sequence, first shunting the regulator and then disconnecting the regulator from the line. Unit has a load current rating of 600 amp, and is designed to handle short-circuit currents up to 20,000 amp. Westinghouse Electric Corp.

3 — CURRENT TRANSFORMER

For indoor or outdoor use, has weather-resistant construction

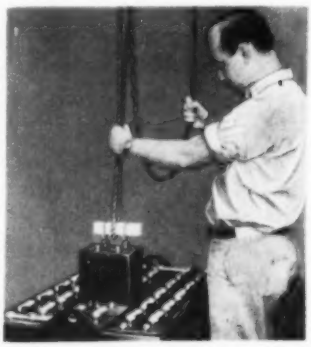
This transformer is molded in thermosetting resin serving as insulation, support, casing, and has conventional accuracy for light burden metering. With 200-amp primary it has ASA classification of 0.03 with the burden B-0.1, and 0.6 with burden B-0.2; 400-, 600- and 800-amp primary has 0.3 accuracy at burdens of B-0.1 and B-0.2.

Several of these light weight transformers can be installed together in a standard meter installation case. The unit's elliptically shaped window accommodates two 500-mcm stranded conductors with 600-v insulation, can be mounted in vertical, horizontal or inverted position. And the base can be rotated 90 deg for greater mounting convenience. Allis-Chalmers Mfg. Co.

4 — CELL PULLER

Useful in removing cells from batteries for examination or repair

This tool, generally used in sets of two, as shown, consists of a U-shaped steel loop brazed to a hexagonal steel nut



with specially-cut threads tapering from bottom to top. The nuts are screwed down over the lead posts, a piece of wood is placed in the loops and the cell is pulled from the battery by a chain or rope. The same tool is also used with hold-down clips for removing the elements from the jar. Gould-National Batteries, Inc.

5 — UTILITY HOSE

Wire reinforced, is designed especially for multi-purpose work

Ironsides Utility Hose can be used as an air hose, oil hose, water hose, gasoline hose or spray hose, it is announced — even for hydraulic lines at working pressures to 1500 psi. Made with a non-porous oil resistant tube, this hose is reinforced with two separate braids, one of steel wire and one of rayon. The steel wire braid is grounded to provide a positive conductor for static electricity. The tough Neoprene cover is colored bright yellow for visibility in dark places. Available in either high pressure re-attachable or pressed-on hydraulic fittings, this hose is made in $\frac{3}{8}$- to 2-in. ID sizes. Quaker Rubber Corp., Div., H. K. Porter Co., Inc.

6 — PIPE WRENCH

Grips tightly, but is designed to treat chrome surfaces kindly

A wrench with a vise-like grip which cannot mar chrome is announced. Adjustable to accommodate phosphor bronze jawlines to fit pipe dimensions from $\frac{1}{2}$ to $1\frac{1}{4}$ in., the wrench also locks in position with a release lever which opens the wrench and frees the pipe when desired. A knurled screw-adjustment tightens so that the phosphor bronze liners are set in position against inner studs, which serve to prevent movement of the liners. The jaws are adaptable for hex inserts to handle nuts and bolts.

Manufacturer of this wrench says it never slips on the pipe, once tightened; yet it cannot mar or scratch the surface of the pipe it holds, and that it will not crush old piping. No change of grip is required for tightening or loosening thread. Robert Austin Corp.

7 — INDICATOR AND ALARM

For combustible gas; samples atmospheres from six locations

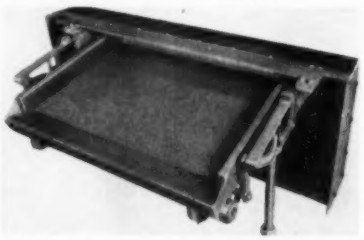
Sequential sampling of potentially explosive atmospheres from six separate locations can be performed by the Model RV-6 Combustible Gas Alarm System, according to manufacturer. (Model variations are available to permit sampling from any number of locations from two to eight.) In operation, the unit draws samples continuously through metallic tubing and analyzes them point by point on a 30-sec cycle. The detecting element is a platinum filament Wheatstone bridge detection circuit. Indication of the presence of combustible gas is provided on a panel-mounted indicating instrument, while the sample line being analyzed is indicated by a series of pilot lights on the front panel. If the combustible gas or vapor reaches a preselected level the instrument stops cycling, shows a red warning light and actuates a remote warning alarm. This lasts until either the combustible is dissipated or corrective measures taken. Johnson-Williams, Ltd.

8 — BURNER UNIT

For automatic anthracite firing; designed to boost boiler capacity

The Fire-Jet, for converting steel or cast iron steam and hot water boilers to automatic firing, is claimed to increase output by at least 15 per cent. The unit is designed to burn low cost rice coal — even smaller barley sizes may be used — or any standard grade.

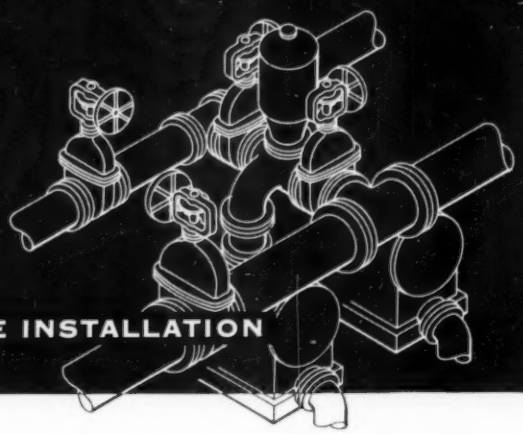
The Fire-Jet consists of a burner installed inside the boiler and gravity-fed with coal from a hopper on the



outside. A 1750 rpm motor drives a fan which forces air through the tuyeres in the burner and supplies power for the mechanism which oscillates the burner periodically and distributes coal over the fire-bed surface. The injector jets, or tuyeres, supply air to the fire bed. Once adjusted, no further air control is necessary, it is explained.

Increase in output is credited to the design which circulates water through the burner to the boiler. This not only speeds up heat transfer, company points out, it also reduces accumulation of mud in the water legs of the boiler. Operational simplicity of the burner is declared such that it is never necessary

These Valves Stay on Job After 50 Years of Water Service



THE INSTALLATION

At the Beaumont City Water Works, Beaumont, Texas, with Crane gear-operated iron body gate valves in main lines in pumping plant.

VALVE SERVICE RATINGS

SUITABILITY: *Always reliable*

FEATURES: *Rugged design in every part*

MAINTENANCE COST: *Routine care only*

SERVICE LIFE: *Still in service—since 1903*

OPERATING RESULTS: *No valve failures*

AVAILABILITY: *Crane Catalog item—Current No. 461*

THE CASE HISTORY

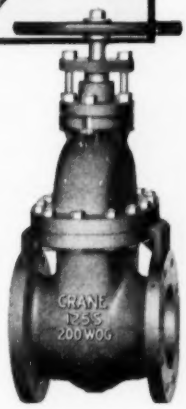
Beaumont taxpayers are still benefiting by the valve quality specified for the Municipal Pumping Station built in 1903. These 14, 16, and 24-inch Crane iron body gate valves remained in their original location until the old plant was converted recently from steam to diesel power. Even then, many were merely cleaned up and put right back in service in the new plant.

For 50 years and more, these Crane valves have given outstanding service at the lowest possible maintenance cost. With but routine care, they remained tight at seat and stem, and always performed with smooth, positive action, despite infrequent operation.

Here's an example of the quality that traditionally sets Crane apart from ordinary valves. It's value like this that has always made Crane the first choice of thrifty buyers in every industry.

THE VALVE

Today's Crane 125-Pound Iron Body Gate Valves with wedge disc are building equally outstanding service records. Highly engineered for durability and dependability at low cost, these valves are now available in the most complete line of patterns and sizes, with a choice of trim for water utilities and other services. Choose to your exact needs from your Crane Catalog, or see your Crane Representative.



THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 528 on Post Card

to clean the fire. Boilers equipped with the Fire-Jet are said to reach top efficiency within 10 min after firing up.

Ten sizes, with burners from 30 to 84 in. long, are available. The 30-in. Fire-Jet has an EDR rating of 3600 sq ft of steam and 5760 sq ft of water; the 84-in. size has ratings of 10,350 and 16,560 sq ft, respectively. Multiple installations may be made in a single boiler. Electric Furnace-Man, Inc.

9 — AIR VALVE

All-metal design — offers flexibility of mounting and application

Here is a wobble-rod type air valve designed to allow greater freedom in pneumatic circuitry. The lever opening and closing the valve is a hardened rod swivelled so that the free end can move vertically, laterally, diagonally or in arcs and circles. The valve can be actuated manually, mechanically or electrically. Its internal exhaust valve will automatically discharge an air cylinder, line or receiver when the valve closes, it is explained, but can be eliminated where it is desirable to hold air line pressures after the valve has done its job. Another integral feature is a check valve (ahead of the ball-and-seat) to prevent backsurge.

The body casting is designed to permit two valves to be assembled into one unit. Such arrangements can provide a common inlet, a common outlet, simple series connection, or total independence of the two valves. Three-way, four-way, tandem, or synchronized operations can be served.

Versatility of installation is the result of both right and left hand outlets ($\frac{1}{4}$ in. ips); a double-ended inlet ($\frac{1}{4}$ in. ips) which can be rotated and clamped through a full 360 deg and a drilled and tapped flange for panel or bracket mounting. The valve will operate in any position, serving as a pilot valve actuating larger controls. Its range of usefulness is up to 125 psig. Open valve diameter is $\frac{1}{4}$ in. Over-all dimensions are $3\frac{1}{4}$ in. by 5 in. by $4\frac{5}{8}$ in. high. Weight is $2\frac{1}{4}$ lb, the price is $23.50. Pantex Mfg. Co.

11 — METAL CONTAINER

Protects transformer and relay coils during storage, transportation

Aptly called a tote-box, this new container is made of cold rolled steel, with all-welded construction, and the sides of the box are embossed to provide necessary rigidity. Special pins at each

corner make it possible to stack the boxes and thus save storage space. When stacked, there are narrow horizontal openings between boxes, through which the transformer or relay leads can extend. And the edges of the boxes on either side of these openings are folded to prevent damaging the coil leads or their paper wrappings. Each box has a holder for identification tags. The boxes are available in two standard sizes. One size is $11\frac{1}{2}$ by 18 by 5 in., and the other is $11\frac{1}{2}$ by 30 by 5 in. Olympic Metals Products Co.

12 — REDUCING VALVES

Small flow; in bronze or steel for steam, air gas, or liquid service

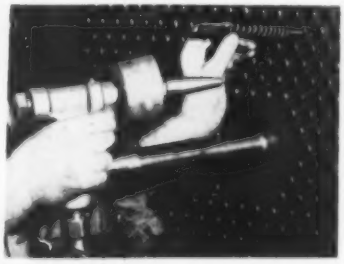
These valves have application where small flows are a problem. Compact and rugged, they are designed to handle inlet pressures to 1000 psi and reduced pressures from 2 to 400 psi. Bulletin 511-A gives capacity tables for four sizes from $\frac{3}{32}$ to $\frac{5}{16}$ in. Leslie Co.

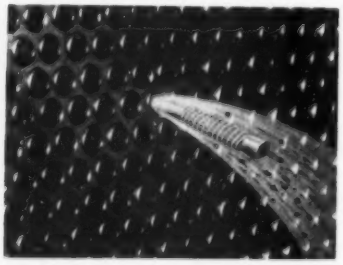
10 — CONDENSER TUBE CLEANING GUN

Shoots brush and water through the tube to get out the sludge

A new tube cleaning team consists of spirally wound nylon brushes and an improved version of company's Jiffy Gun. The spiral design of these brushes gives them a spinning, scouring motion which, together with the flushing action of the water, acts to remove sludge and other soft deposits from small tubes of condensers and heat exchangers. The brushes have little rubber bumpers at either end which are a little smaller than the tube. These let the water pass and impart the spinning action.

To work the Jiffy Gun you insert the brush into a tube, and press the gun nozzle into the tube end. This releases the water pressure and the brush shoots through. The brushes won't stick in the tubes, company says, and they can be used over again. In most condensers it is necessary to open the waterbox; the brushes are recovered through handholes at the other end. Air may also be used as the operating medium for the gun, but water is preferred for its flushing action. Lagonda Div., Elliott Co.



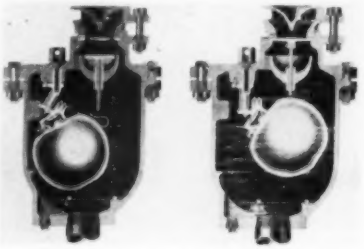


You may use the post cards on pages 35 and 117 to ask for further information on any of these new products

13—AIR RELEASE

And air inlet valve for pipe lines, designed to perform three jobs

This, the Type AV Air Release and Vacuum Breaking Valve, has been designed to provide a compact unit having the functions of automatically releasing air accumulations from pipe systems and, admitting air to systems for breaking vacuums within these systems, and venting large quantities of air from pipe lines when filling the systems with water. Company says it is constructed to combine these three functions and permit the intake and exhaust of air through



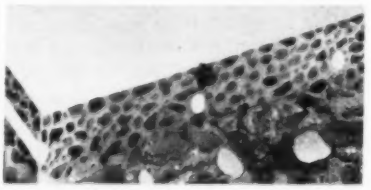
one valve body. Since it has a 2-in. threaded inlet opening, it provides a smaller unit than ordinarily furnished for vacuum breaking purposes, it is noted; and because of its size it can be installed in confined quarters.

This form of valve is suggested for use under working pressures to 150 psi wherever air accumulations are found in pipe lines and where difficulty of water flow is experienced due to air binding. The valve is $11\frac{1}{2}$ in. dia, $16\frac{1}{4}$ in. high; each unit weighs 160 lb. Simplex Valve & Meter Co.

14 — INDUSTRIAL FLOORING

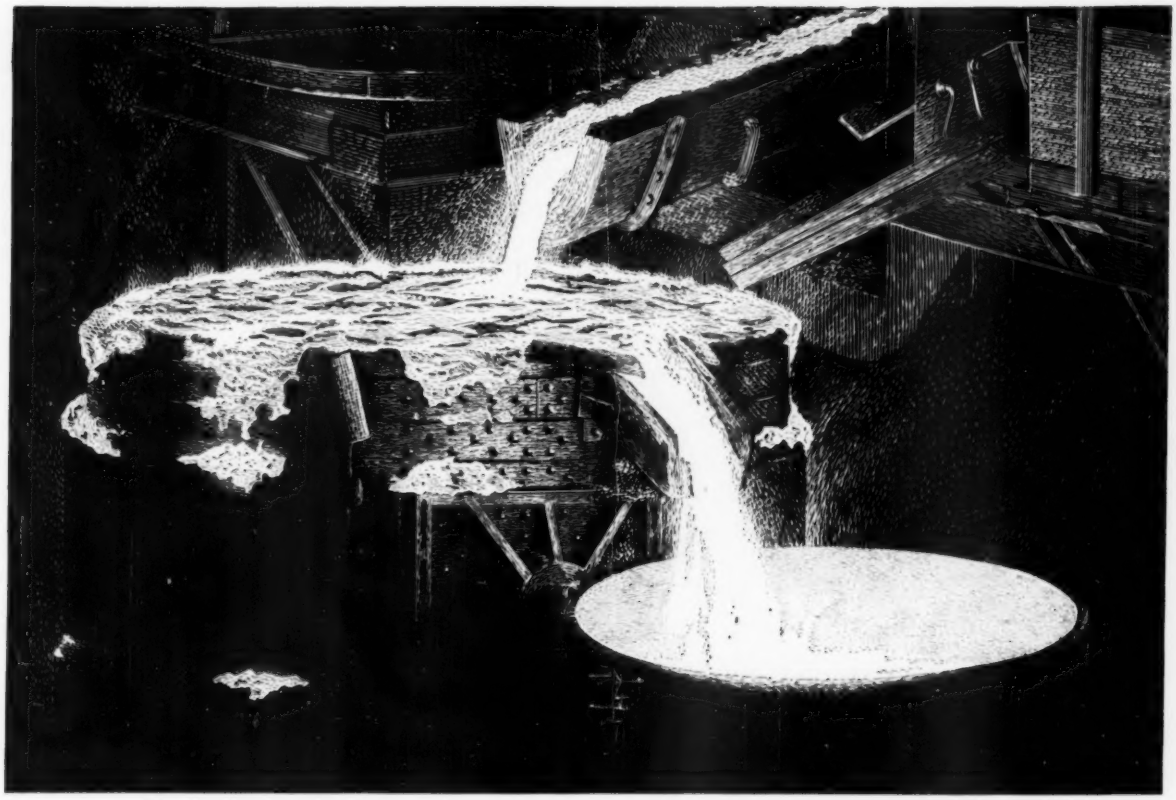
Designed to withstand thermal shock and deterioration from heat

This flooring, for use where temperatures range up to 2000 F, disperses heat through aluminum rods (see arrow)



about 1 in. below the surface, it is explained, and because of their high thermal conductivity these embedded rods carry the heat from the contact area and spread it over a wide section.

Newest of the floorings developed by the manufacturer, this heat-resistant type utilizes Dynapakt Concrete. According to company, this concrete consists of hardest graded rock and sand combined with cements in low-water ratio and power compacted for greater density; it is designed to stand up under industrial traffic. Flash-Stone Co., Inc.



A top steel producer reports increase:

From 220 to 330 tons per day with Cities Service Heat Prover!

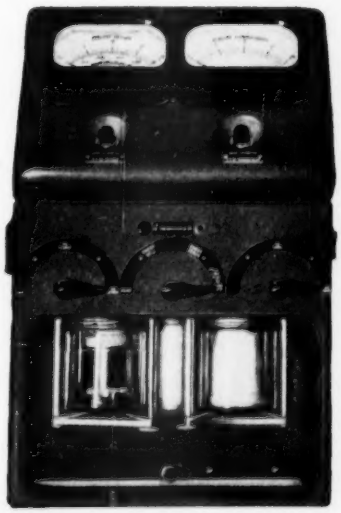
Tap-to-tap time reduced from 18 hours to 12 hours! . . . Fuel cut 5%! . . . Tonnage up 50% daily! That's the amazing job the Cities Service Heat Prover helped perform for one of the country's biggest steel producers.

They were running a batch size of 165 tons, with a tap to tap time of 18 hours, using 400 gallons of fuel per hour. After the Heat Prover readings were translated into actual readjustments, TAP-TO-TAP TIME WAS CUT TO 12 HOURS, ALLOWING TWO FULL BATCHES EVERY 24 HOURS INSTEAD OF EVERY 36 . . . AND FUEL WAS CUT TO 320 GALLONS PER HOUR!

Remarkable? Sure . . . and it's the kind of a job the Cities Service Heat Prover can do wherever a furnace operation is involved by providing:

• Rapid, continuous sampling • Simultaneous reading and direct measurement of oxygen and combustibles • Easy portability • No maintenance or recalibration.

For details, contact nearest Cities Service office or write Cities Service Oil Company, Dept. K17, Sixty Wall Tower, New York City 5, N. Y.



FREE—NOT AN INSTRUMENT YOU CAN BUY, BUT A SERVICE WE SUPPLY!

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

For more data circle 529 on Post Card

15 — VIBRATION RELAY

Is designed for the protection of large rotating equipment

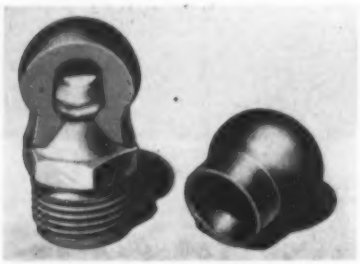
This new protective device initiates a signal when excessive vibration due to unbalance occurs in large rotating equipment. Specifically engineered for apparatus which is left unattended for long periods, it can be used on turbine or water-wheel generators, large motors, blowers, steam or gas turbines, and centrifuges. The relay has an operating range which allows its use at speeds from 300 to 18,000 rpm to energize warning-alarm, corrective, or shut-down devices at pre-set vibration acceleration values up to 20 g. Design features of this new relay are intended to permit easy calibration and safe installation where dust conditions exist.

A fail-safe feature gives warning when the device itself fails, because of filament burn-out or loss of line voltage, it is explained, and will cause the normally energized relay to be de-energized. General Electric Co.

16 — GREASE FITTING COVER

To keep dust and other abrasives from entering the fittings

Zur-Kaps are made of oil-resistant Neoprene and designed for use on all equipment using Zerk- or Alemite-type



fittings. These covers are claimed to eliminate danger of excessive wear from dirt particles normally forced into the unprotected fittings with each application of new grease. Manufacturer says they're easy to snap on and off, and also save time usually required to clean fittings before each lubrication. Winner Mfg. Co.

17—INDICATING MATERIAL

For 525F temperature; available in stick, lacquer or pellet form

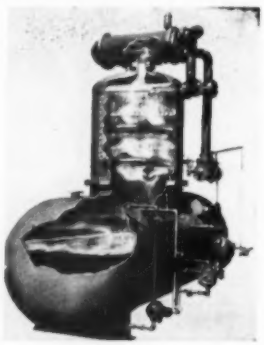
While Tempilstiks, Tempilaq and Tempil Pellets for 500F and 550F have been available for some time, there has been a demand for temperature-indicating material to signal the intermediate 525F range. The new products are offered to meet that need. Tempil Corp.

18 — FEEDWATER HEATER

Spray-type deaerating unit, for quiet operation, low maintenance

The only part of this feedwater heater that requires cleaning is the spray distributor which may be removed without breaking piping connections. There are no loose baffles or trays, says manufacturer. The heater is intended for use by power plants operating with a boiler pressure of 75 lb or more. Capacities in the various models range from 3000 to 300,000 lb of preheated feedwater per hour. Any desired storage capacity may be incorporated.

Main feature of this heater is a series of four permanently installed semi-circular baffles which slope downward to the straight edge. Edges are upturned and serrated, and project slightly past the heavier center line. Raw water is sprayed onto the upper baffle. As it cascades over the serrated



edges in a series of thin streams, it comes in direct contact with the rising steam. Air and noncondensable gases are swept upward to the vent condenser where steam is condensed to form feedwater, and corrosive gases are vented. Stickle Steam Specialties Co.

19 — PLUG VALVES

Semi-steel, steel lubricated types, screwed or bolted gland design

Features announced for these lubricated plug valves include quick and positive shut-off, and wrench-operation requiring

only a quarter turn to open or close. Lubricant grooves surrounding each port are designed to provide a positive seal when valves are closed. In an open position, seating surfaces are not exposed. Semi-steel valves are available for 175 and 200 lb (water, oil, gas) and carbon steel valves for 150 and 300 lb water pressure. An illustrated booklet describing these valves is available. The Wm. Powell Co.

20 — GLOVE DRYER

Made of aluminum, equipped with a drip pan and draining faucet

Use of this aluminum dryer preserves rubber gloves and keeps them wearable longer, says manufacturer. It has its own drip pan and draining faucet and comes mounted on a sturdy mahogany-finished wooden base for attaching it to the wall.

Two models are offered: the Model 38, with 12 prongs (shown at right), dries six pairs of gloves. It costs $22.50. The Model 40, with 24 prongs, dries 12 pairs, and costs $37.50. General Scientific Equipment Co.

21 — CURRENT TRANSFORMER

Through type for outdoor use in 200-, 400-, 800-amp primary

Utilization of the biased core principle and Hipersil core in these transformers are said to assure high accuracy with smallest practical size and weight. According to manufacturer the 200/5 amp rating meets ASA 0.3 accuracy standards at B0.1 burden, as do the 400/5 and 800/5 amp ratings at B0.1 and B0.2. Both the 200/5 and 400/5 amp transformers have a rating factor of two, and the 800/5 amp transformer has a rating factor of 1.5.

The use of mica, glass silicone, and silicone-treated insulation material are said to make possible a simple, moisture-resistant unit. The secondary terminal block is inside the metal case, and an obround, silicone glass laminate tube provides an opening suitable for single-phase, three-wire, or three-phase, four-wire metering of standard 600-v power cables. Provision is made for secondary conduit connection, and structural parts are furnished to resist rust and corrosion. Westinghouse Electric Corp.

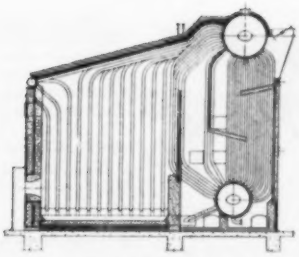
22 — DUST COLLECTOR

Is self-cleaning cloth screen unit incorporating reverse air flow

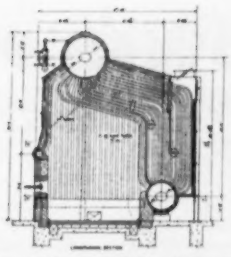
Designed to lower operating and maintenance costs by permitting continuous automatic dust collection, the CH-3 Collector uses the principle of reverse air flow for cleaning of its cloth filters. This is accomplished by a traveling manifold whose integral reverse air blowers take air directly from the clean air side of the collector.

The manifold covers three vertical rows of cloth-covered screen frames at once. The reverse flow of air is blown through the center row of screens while normal air flow through the other rows is blocked off by the flexible diaphragm on the manifold which is inflated against the grid wall under flow of pressure when the blower unit is centered on a particular row. This mechanical arrangement causes dust to be blown from external surfaces of the filter elements, and lets it drop into the hopper instead of being entrained; it also acts to prevent air short circuiting. The blower motor in the traveling manifold is interlocked with the main exhauster motor.

The manifold travels at slow speeds in both forward and reverse motions. Because the collector operates continuously, there is no need for shut downs for mechanical cleaning, it is explained. And because dust accumulation on the cloth surfaces is maintained at a uniform value, the air flow resistance of the collector remains relatively constant. Pangborn Corp.



2 Drum Water Tube Boiler



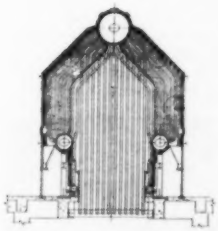
Type-S 2 Drum Boiler Series 51

FOR ALL INDUSTRY...

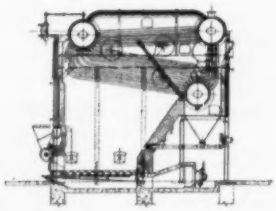
WICKES

STEAM GENERATORS

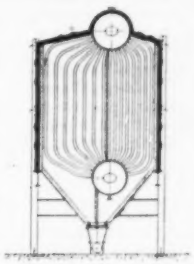
• In the oil, paper and chemical industries and in manufacturing plants, institutions and public buildings throughout the world Wickes Steam Generators are in constant daily service. All types, such as those illustrated on this page, with capacities up to 250,000 lbs. steam per hour and 1000 psi. Write for descriptive literature.



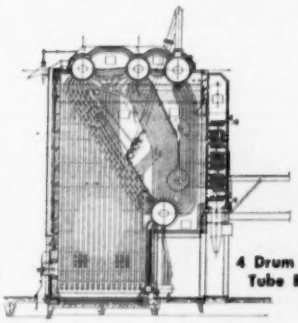
"A" Type Water Tube Boiler



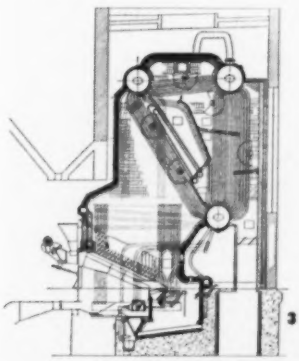
3 Drum Low Head Water Tube Boiler



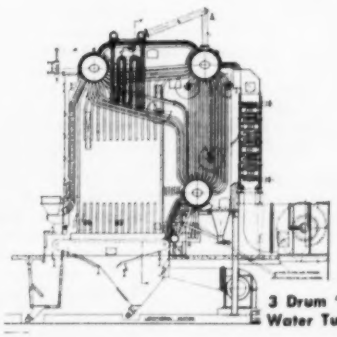
Wickes 2 Drum
Waste Heat Installation



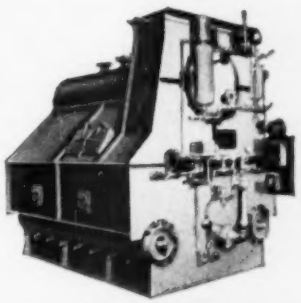
4 Drum Water
Tube Boiler



3 Drum Water
Tube Boiler



3 Drum "B" Type
Water Tube Boiler



Type "A" "Packaged" Steam Generator

THE WICKES BOILER COMPANY • DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

POWER PLANT *Construction News*

Siluria, Ala. — Buck Creek Cotton Mills, sheetings and other cotton goods, is reported planning new boiler house in connection with proposed rebuilding of local mill destroyed by a tornado a number of weeks ago. Planned to begin work at early date. Entire program is estimated to cost about $750,000.

Tuscaloosa, Ala. — B. F. Goodrich Co., 500 South Main St., Akron, Ohio, plans extensions in power house at branch rubber plant at Tuscaloosa, used for manufacture of automobile tires and tubes, in connection with a large expansion program, to increase capacity about 30 per cent. Cost reported over $4,000,000. Work will be carried out over a period of months.

Gorgas, Ala. — Alabama Power Co., Birmingham, Ala., has plans for new addition to power plant at Gorgas, reported to cost about $2,000,000. Work is scheduled to be placed under way soon.

Los Angeles, Calif. — J. I. Holcomb Mfg. Co., 1601 Barth St., Indianapolis, Ind., chemicals for cleaning, disinfecting, etc., plans boiler plant for processing and other service at proposed new factory at Los Angeles. Cost reported about $300,000. Proposed to begin work soon.

Pueblo, Colo. — State Department of Institutions, State Office Bldg., Denver, Colo., plans extensions in central steam power house, used for heating service at State Hospital at Pueblo, with installation of additional equipment. Cost estimated about $700,000. Rocky Mountain Engineering Co., 1435 Welton St., Denver, is consulting engineer.

Seaford, Del. — Southern States Cooperative, Inc., 2101 East Fort Ave., Baltimore, Md., plans boiler house at proposed new mill for manufacture of animal feed at Seaford, where site has been selected. It will comprise several production buildings and is reported to cost approximately $1,000,000. Proposed to carry out work soon.

Chattahoochee, Fla. — Florida State Improvement Commission, Caldwell Bldg., Jacksonville, Fla., has plans under way for new boiler house at State Hospital, Chattahoochee. Work will be carried out in conjunction with new electrical distribution system at institution, entire project to cost about $1,200,000. Reynolds, Smith & Hills, 227 Park St., Jacksonville, are architects and engineers.

Tampa, Fla. — Tampa Electric Co., Tampa, plans bond issue of $8,000,000, proceeds to be used for expansion and improvements in plants and system, including new generating station at Black Point, Hillsborough Bay, recently reported in these columns. Other work will include power substations, transmission lines, etc.

Atlanta, Ga. — Carrier Corp., Syracuse, N. Y., air-conditioning equipment, is reported planning steam-generating station at proposed new branch plant in vicinity of Atlanta. It will consist of several units, equipped for large capacity. Entire project is estimated to cost about $5,000,000.

Pittsfield, Ill. — Illinois Rural Electric Co., Winchester, Ill., has plans for extensions in power plant at Pittsfield, with installation of additional equipment. Also, will make improvements in power plant at Winchester, with additional facilities. Stanley Engineering Co., Hershey Bldg., Muscatine, Iowa, is consulting engineer.

Norco, La. — Shell Chemical Corp., Shell Bldg., Houston, Tex., plans boiler house at proposed new plant at Norco, for production of glycerine and similar products. It will consist of several large units and is reported to cost about $5,000,000. Main office of company is at 50 West 50th St., New York, N. Y. Company is a subsidiary of Shell Oil Co., last noted address.

South Paris, Me. — A. C. Lawrence Leather Co., Peabody, Mass., plans boiler house for processing and other service at proposed new leather tannery at South Paris, where property has been acquired. It will comprise a number of buildings for different branches of service, and is reported to cost about $500,000. Company is a subsidiary of Swift & Co., Union Stock Yards, Chicago, Ill.

Waltham, Mass. — Department of Mental Health, Commonwealth of Massachusetts, 15 Ashburton Pl., Boston, Mass., plans extensions in power house at W. E. Fernald School, Waltham, (operated by department), used for central-heating service. Cost estimated approximately $300,000. Proposed to carry out work soon. Charles T. Main, Inc., 80 Federal St., Boston, is consulting engineer.

Jackson, Miss. — Swift & Co., 300 West Capitol St., meat packer, is reported planning boiler house at proposed new meat processing and packing plant on local site. It will comprise several buildings and is reported to cost about $850,000, with equipment. Main offices of company are at Union Stock Yards, Chicago, Ill.

Independence, Mo. — City Council has engaged Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers, to prepare plans for proposed extensions and improvements in municipal power plant, recently noted in these columns. Work will include installation of a 5000-kw turbine-generator, boiler and auxiliary equipment. Program has been revised for expenditure of $1,500,000, instead of $3,000,000, as initially projected. Bond issue is being arranged.

Hightstown, N. J. — Hightstown Rug Co., Hightstown, rugs and carpets, plans steam power plant at proposed new mill in East Windsor Township, near Hightstown, where tract of 45 acres of land has been acquired. It will consist of several buildings and is reported to cost about $2,250,000. Work is scheduled to begin soon.

Nyack, N. Y. — Rockland Light & Power Co., Nyack, is arranging for a bond issue of $8,000,000, and common stock issue of about $2,500,000, majority of proceeds to be used for expansion and improvements in power plants, power substations, transmission lines and other operating facilities.

Burgar, N. C. — Volunteer Portland Cement Co., 502 Gay St., S.W., Knoxville, Tenn., plans power house at proposed new cement mill in vicinity of Burgar. Several large buildings will be erected, with processing and other equipment for sizable output. Cost reported approximately $2,500,000. Proposed to begin work soon.

Roanoke Rapids, N. C. — Virginia Electric & Power Co., 17th and Franklin Sts., Richmond, Va., has plans under way for new hydroelectric generating station at Roanoke Rapids, initially projected a number of months ago. It is estimated to cost about $33,000,000, including power dam, hydraulic turbines and generators, switching station, transmission lines and other operating facilities. Another hydroelectric generating station is being considered at Gaston, N. C., for which details and estimates of cost will be determined soon.

Cincinnati, Ohio — American Bitumuls & Asphalt Co., 200 Bush St., San Francisco, Calif., plans power house at new asphalt refining plant at Miami Ford, near Cincinnati, where tract of about 100 acres of land has been purchased, fronting on Ohio River. It will comprise a number of one- and multi-story buildings, with processing and other equipment for large capacity. Entire program will represent an investment of close to $4,000,000. Company is a subsidiary of Standard Oil Co. of California, 225 Bush St., San Francisco.

Charleston, S. C. — Bird & Son, Inc., East Walpole, Mass., roll roofing, asphalt shingles and other building specialties, plans boiler house at new branch plant at Charleston. It will consist of several large production buildings and is reported to cost more than $2,000,000. Work is scheduled to proceed at once.

Amarillo, Tex. — Texas Co. plans new boiler plant with high-pressure boilers and accessories, in connection with an expansion program at local oil refinery. Entire project estimated to cost several million dollars. Work will be placed in progress soon. Main offices are at 720 San Jacinto St., Houston, Tex.

Littlefield, Tex. — Southwestern Public Service Co., Amarillo, Tex., plans extensions and improvements in power plant near Littlefield, with installation of additional equipment. Cost estimated over $200,000.

San Antonio, Tex. — San Antonio Public Service Board, 201 North St. Mary's St., has preliminary plans under way for new municipal steam-electric power plant, reported to cost over $8,500,000, with turbine generator, high-pressure boilers and auxiliary equipment.

Newport News, Va. — Pan-American Refining Corp., 122 East 42nd St., New York, N. Y., plans power house at new oil refinery at Goodwin Neck, near Newport News, where tract of about 1000 acres of land has been purchased. It will consist of a group of steel frame structures, equipped for a rated capacity of 25,000 bbl per day. Entire project will cost several million dollars.

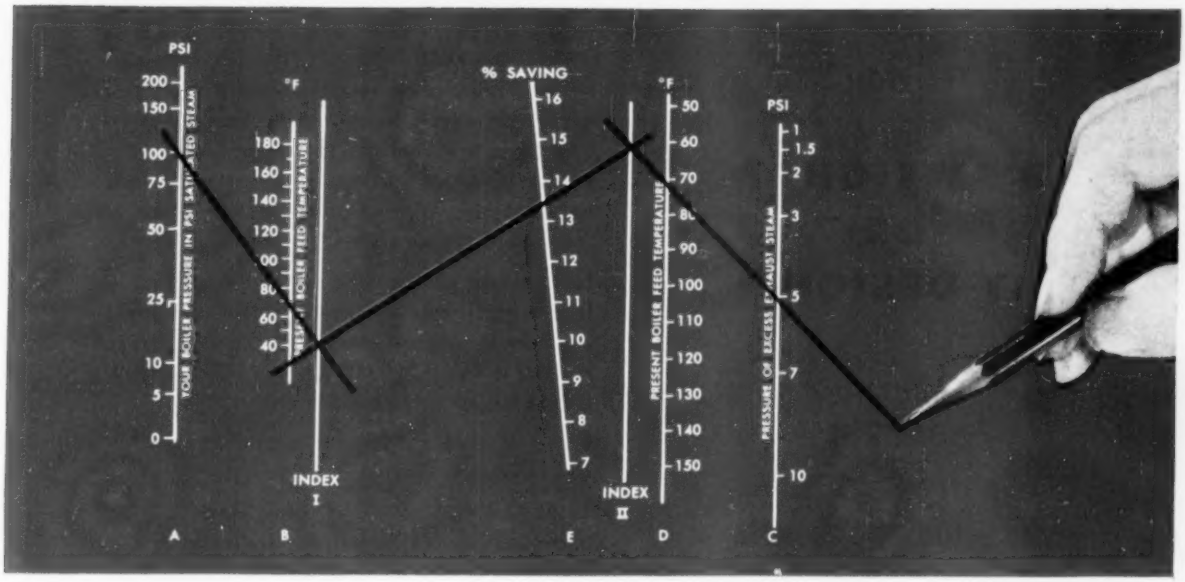
Quantico, Va. — Virginia Electric & Power Co., 7th and Franklin Sts., Richmond, Va., plans extensions in steam-electric generating station at Possum Point, near Quantico, with installation of new turbine generator, high-pressure boilers and auxiliary equipment. Cost reported close to $15,000,000. Work is expected to be placed under way at early date.

Green Bay, Wis. — State Department of Public Welfare, State Capitol, Madison, Wis., has authorized plans for new power plant at State Reformatory, Green Bay. Details and estimates of cost will be determined soon. Proposed to ask bids early in 1954. Roger C. Kirchhoff, State Capitol, is state architect.

Manitowoc, Wis. — Manitowoc Engineering Corp., cranes and other heavy equipment, has approved plans for new steam-generating station at plant, estimated to cost approximately $200,000, with boilers and auxiliary equipment.

Mendota, Wis. — State Department of Public Welfare, State Capitol, Madison, Wis., has plans under way for new power plant at institution at Mendota, reported to cost approximately $1,000,000, with equipment. Bids are expected to be asked early in 1954. Battey & Childs, 231 South LaSalle St., Chicago, are consulting engineers.

Use exhaust steam and cut fuel costs with a Swartwout Feed Water Heater

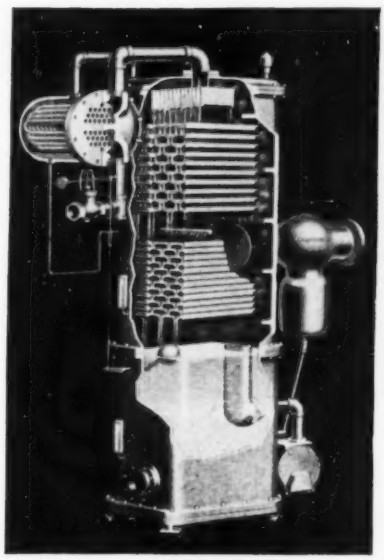


1 **UTILIZING RESIDUAL HEAT** in exhaust steam, you effect a direct saving in fuel costs of approximately 1% for each 11°F increase in boiler feed water temperature. Furthermore, you improve boiler operation in other important, cost-cutting ways. Faster steaming rate . . . removal of the soluble gases that cause costly corrosion in boiler and economizer . . . reduction of temperature strains.

Here's how to figure your fuel savings. Connect point on A to point on B; project line to intersect Index I. Connect points on C and D; project line to intersect Index II. Connect points on I and II and read your fuel savings on Scale E. The example given (100 psi saturated steam boiler using 70°F feed water and 5 psi exhaust steam) shows a *saving of approximately 13.6% of your present fuel cost.* A-5063

Swartwout

POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION

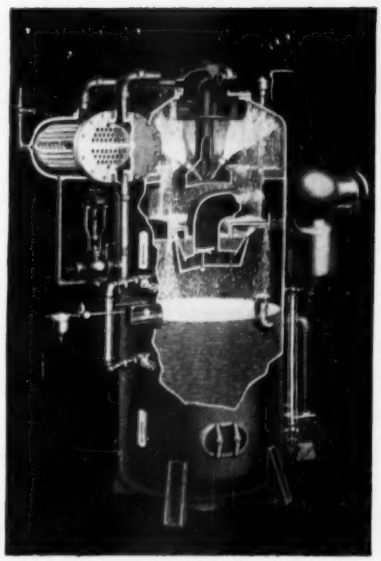


2

SWARTWOUT TRAY TYPE HEATERS, by using counterflow principle, give greatest degree of deaeration because water is in contact with clean steam just before dropping into storage section. Swartwout cast iron or steel deaerating heaters (.03 oxygen guarantee) and deaerators (.005 oxygen guarantee) can be supplied with cast iron or stainless steel trays.

3

SWARTWOUT SPRAY TYPE (atomizing) deaerators are of all-steel construction, give feed water with oxygen content guaranteed not to exceed .005 cc per liter of water. All surfaces which are subjected to impingement of water are made of corrosion-resistant stainless steel. Swartwout feed water heaters are specially designed to meet your individual requirements and range from 5000 to 300,000 lb. capacities.



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For more data circle 531 on Post Card

Deaerating Heaters

BY WEIGHT? OR BY DESIGN?

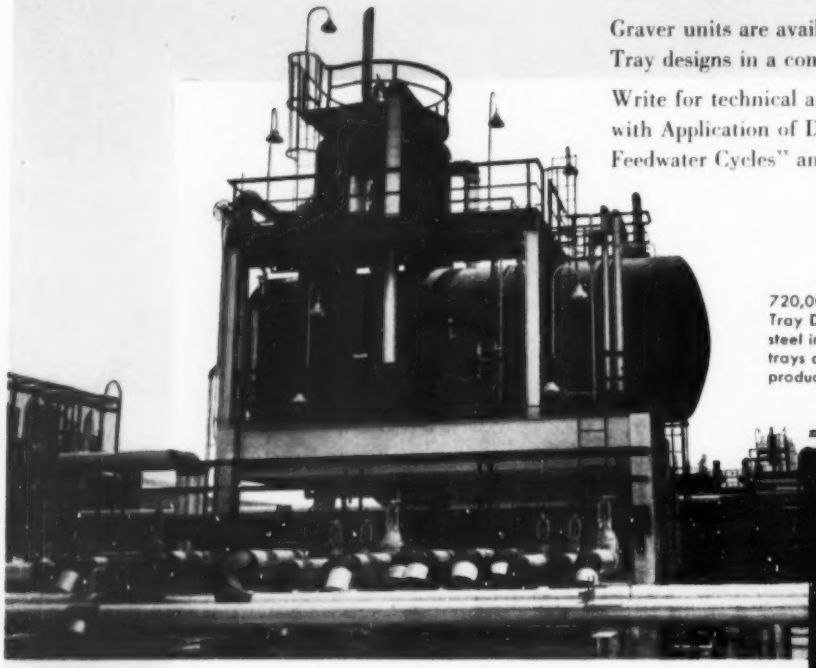
Forty-five years ago, deaerating heaters were built of cast iron trays and outer shells. Cast iron was corrosion resistant, but was also heavy and cumbersome.

Today, Graver's effective design has eliminated the need for this excessive weight. Yet, Graver Deaerating Heaters are corrosion resistant and structurally strong. *Stainless steel* is used for all internal parts in contact with corrosive water or atmosphere as well as for internal vent condenser, trays and trim. All other parts of the vessel are constructed of high grade carbon steel.

Furthermore, although the weight of Graver Deaerating Heaters has decreased over the years, the efficiency in oxygen removal has increased. Oxygen removal to less than 0.005 ml/liter is obtained in Graver heaters without difficulty.

Graver units are available in Spray, Tray, and Spray-Tray designs in a complete range of sizes.

Write for technical article, "Experiences with Application of Deaerating Heaters in Feedwater Cycles" and bulletins.



720,000 lb. per hr. Graver Spray-Tray Deaerating Heater with stainless steel internal vent condenser and trays at a southwestern metal-producing plant.

Graver stainless steel tray

GRAVER WATER CONDITIONING COMPANY

Division of Graver Tank & Mfg. Co., Inc.

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In Canada: The Bird-Archer Co., Ltd., Cobourg, Ontario
In Mexico: Proveedores Tecnicos, S.A., Pueblo 259, Mexico 7, D. F.

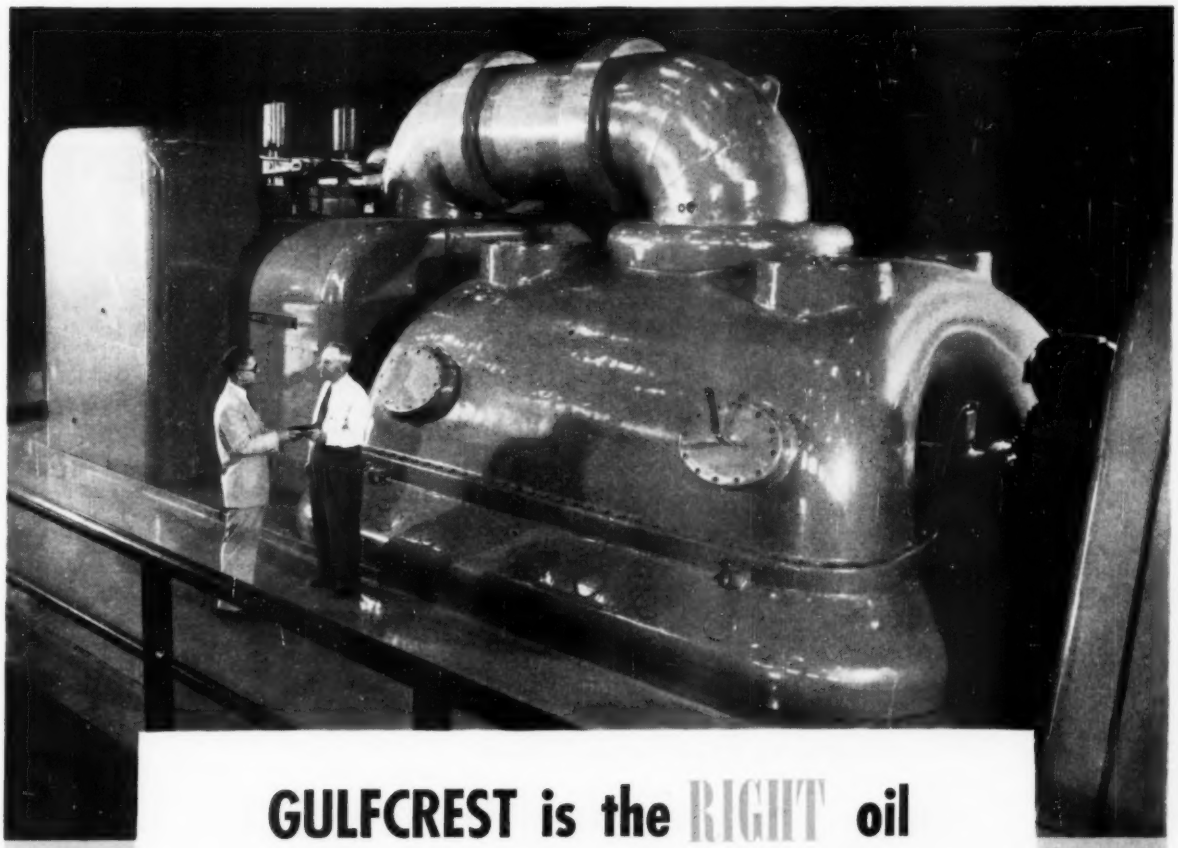
GRAVER *Deaerating Heaters*

EQUIPMENT FOR ALL WATER AND WASTE TREATMENT PROCESSES

GW-482

For more data circle 532 on Post Card

View of the 100,000 kw Westinghouse turbine in the Acme Station of the Toledo Edison Company. In addition to this turbine, a 60,000 kw General Electric turbine and a 50,000 kw Westinghouse turbine are also lubricated with Gulfcrest Oil.



GULFCREST is the RIGHT oil for every steam turbine

the RIGHT base stock, Alchlor-processed

the RIGHT combination and concentration of additives

the RIGHT background of performance

Gulfcrest Oil has a background of successful performance in every type and make of steam turbo-generator.

In many of these installations the original charge of Gulfcrest has been in service more than 10 years with no significant change in its original characteristics, and with neutralization numbers always remarkably low and safe.

To get this kind of lubrication for your turbine, call in a Gulf Sales Engineer and ask him to recommend the proper grade of this superior oil. Write, wire, or phone your nearest Gulf office today.

Gulf Oil Corporation · Gulf Refining Company

Pittsburgh 30, Pennsylvania

GULF SERVES INDUSTRY

For more data circle 533 on Post Card

3000 impulses help keep mid-west refinery "on stream"

THIS big refinery at Lawrenceville, Ill.—like a lot of other important refineries — uses Yarway Impulse Steam Traps.

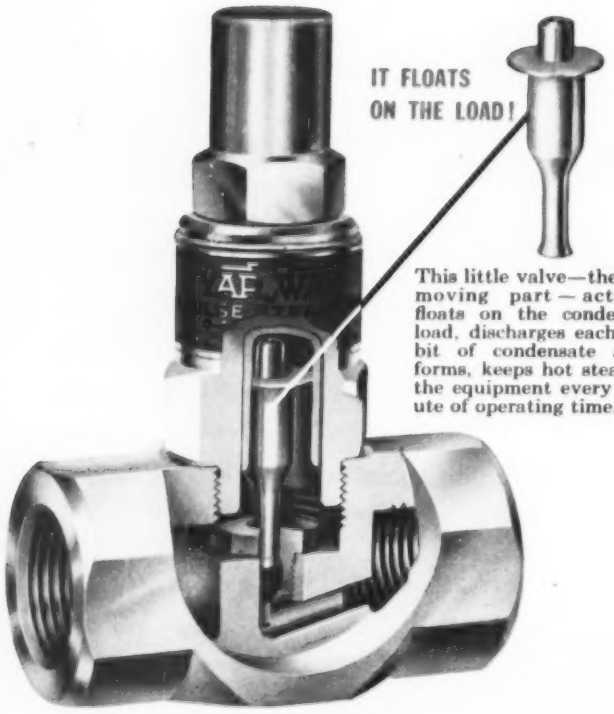
Over 3000 Yarway Impulse Traps are installed on tracer lines and for draining steam headers.

Popular features of the Yarway Impulse Steam Trap are its ability to get equipment *hot in a hurry*—and keep it hot! . . . also its small, handy size—fits in easily in any location; its stainless steel body and working parts; quick installation; easy maintenance; low initial cost.

Another advantage — IMMEDIATE DELIVERY from 250 local distributors, plus quick service from nearby Yarway field engineers.

More than 900,000 Yarway Impulse Steam Traps have been sold. For a free Steam Trap Selector, write . . .

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.



This little valve—the only moving part — actually floats on the condensate load, discharges each tiny bit of condensate as it forms, keeps hot steam in the equipment every minute of operating time.

YARWAY® impulse® steam trap

For more data circle 534 on Post Card

How to Reduce Line Voltage Dips When Starting A-C Motors

If you have a synchronous motor anywhere in the system, or can put one in, here's simple way of using it to solve this problem

By **EDWARD H. STIVENDER,** Consulting Engineer

VOLTAGE DIPS caused by inrush currents during the starting of a-c motors are, of course, familiar to anyone used to operating electrical equipment. Where an installation has several motors, there are often simple methods to minimize these voltage dips, and it is well to look over all the equipment for possibilities before concluding that nothing can be done.

Since the transient voltage and current are due almost entirely to the low lagging power factor currents needed for the starting torque of the motor, if we can provide these currents from some local source, the line voltage will be unaffected. A synchronous motor, of somewhere near the power rating of any one of the motors to be started, provides a ready source that can be used quite easily with a few control wiring additions.

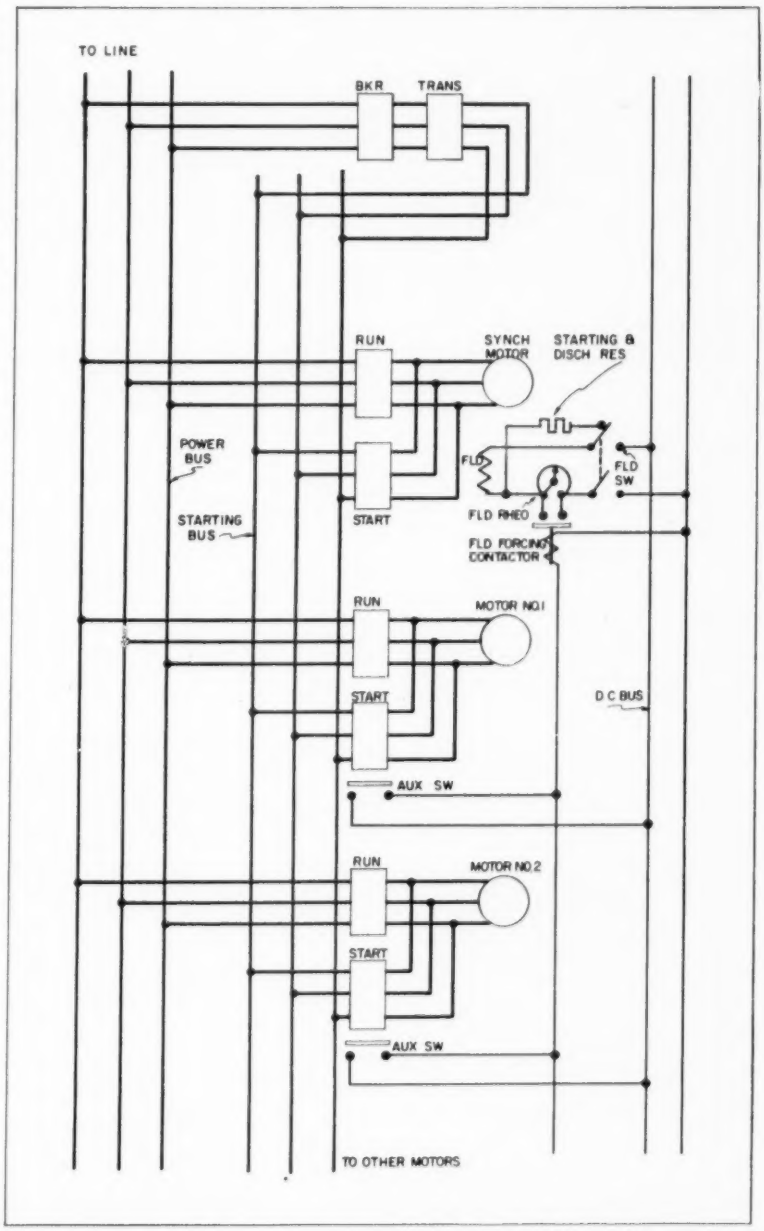
Use Synchronous Motor

Figure 1 illustrates the method. There are so many power circuit variations in practice that the basic idea only is represented here. A contactor automatically short circuits the field rheostat of the synchronous motor while any of the other motors are being started. A synchronous motor that is over-excited acts as a condenser, drawing leading current from the line, thus neutralizing the lagging current drawn by the other motor at starting.

When the starting period is over, the contactor automatically opens. The diagram shows how interlock switches on the starting circuit breakers actuate the contactor. By using this method, not only are voltage dips minimized, but the starting time of the motors is reduced substantially and motors already loaded are kept from pulling out of step.

Where motors start across-the-line, current relays may be used to actuate the field forcing contactor and disconnect it when the motor current decreases to normal. The advantages of this method apply whether the motors to be started are synchronous or induction.

When new motors have to be installed, it is a good idea to select at least one synchronous motor, if for no other reason than that it can minimize the transient conditions during starting of the other motors.



Over-exciting of the synchronous motor causes it to draw leading current from line. Leading current neutralizes lagging current of the motor being started and reduces line current surges and voltage dips

Outdoor Water Softening Plant for Bayway Refinery

Even in colder climates, outdoor plant construction pays off. Esso Standard Oil Co., proves it with its hot lime-zeolite plant

By OSCAR SHEPSTONE and GEORGE WOLFE

Construction Department, Machinery Division, Dravo Corporation

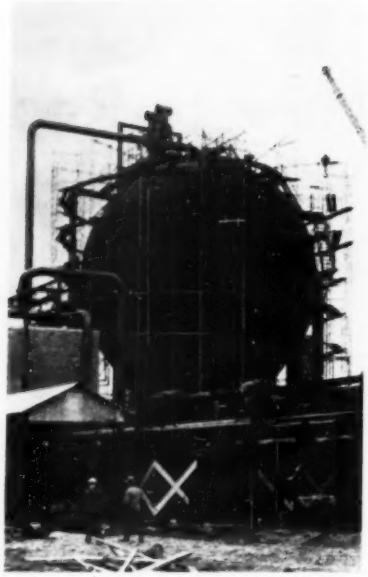


Fig. 1. Sphericone sedimentation tank, first step in softening process, is shown here under construction

INSTALLATION of a continuous water treating plant at the Bayway Refinery of Esso Standard Oil Co., located in Linden, N. J., called for careful layout because space was at a premium. The resulting plant, now installed and operating, was primarily outdoors. The compact arrangement of equipment and piping was erected on a site 84 ft wide by 130 ft long.

All tanks and equipment are located outdoors except the lime, phosphate and sulfite mixing tanks, which are in the mixing room of the control house. The control house, located at one corner of the site, is a two-story steel-framed building with brick walls and concrete roof and floors. The basement of this building was carried down to a depth of 10 ft and is used for wet salt storage, brine generation and brine storage. The building is 25 ft by 42 ft 4 in. in plan with one-third of the ground floor serving as the control room and the remainder housing the indoor mixing equipment. The second floor provides space for wash and locker rooms with two-thirds of the area reserved for a chemical storage space.

Chemicals are delivered by truck in bags and, for the unloading and storing of this material, electric monorail hoists are provided with the monorail beams cantilevered outside the building so the chemicals can be lifted directly from the trucks. Charging hoppers, with chutes running down to the lime mixing tanks, permit the lime to be dumped into the tanks from the storage room above. Salt is also received by truck delivery and is stored in the basement. Brine is generated by allowing fresh water to trickle through the salt. The brine is then collected in a piping system and runs by gravity to the brine storage tank also located in the basement.

Due to unstable surface soil conditions it was necessary to carry all outdoor tank and pump foundations down to a depth of 7 ft below grade. All switchgear was mounted on a concrete slab 12 ft by 32 ft with a protecting roof only. Amesite walkways were provided around the pumps, under the sedimentation tank and around the control house. Three-quarter-in. crushed stone was used in the areas not covered by Amesite.

All switches and starters, which are of the oil immersed type, are mounted on a switch rack on the concrete slab. A special heavy plate duct, located above the switch rack, encloses the main distributing bus bars. All outgoing power and control circuits are in buried conduit encased in concrete. Yard floodlighting and a very complete lighting system for the sedimentation tank are provided. For convenience in maintenance, several heavy duty weatherproof welding outlets are located at various points in the equipment area.

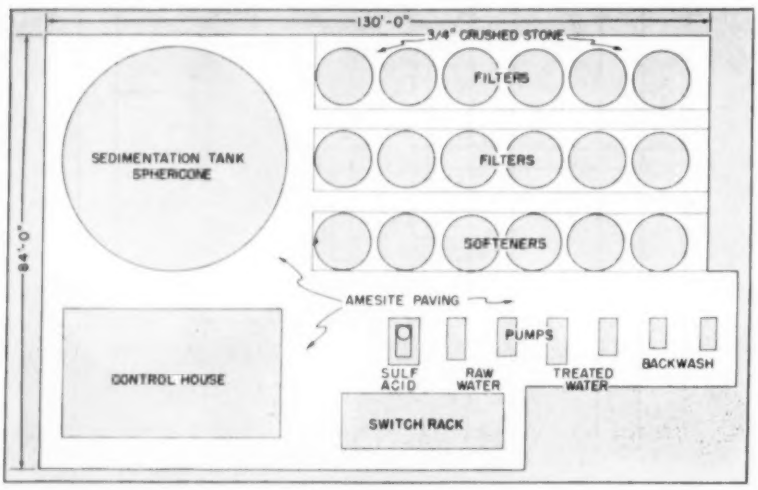


Fig. 2. Compact arrangement of semi-outdoor softening plant allowed installation of the sedimentation tank, filters, zeolite softeners, water pumps, control house, and switch rack in space 84 by 130 feet

Control Room

Since the operation of the entire water treating plant is centered about the control room, this room was given some special treatment from the architectural viewpoint, although the rest of the plant was strictly utilitarian. All walls are covered with glazed tile, a suspended ceiling conceals overhead piping, and all lighting fixtures are of the recessed type. Laboratory equipment provided for testing of the treated water consists of stone-topped floor cabinets and sink with additional wall storage cabinets. A large number of test lines with constantly running water serve the control room, and stainless steel troughs equipped with splash screens carry the runoff into the sewer system.

The main control board, located in one corner of the control room, consists of a panel about 42 in. wide with side panels of about the same width set at an angle of 45 deg so that the entire unit fits into the corner of the room. The panels are carried up to the suspended ceiling and the entire unit is set away from the walls far

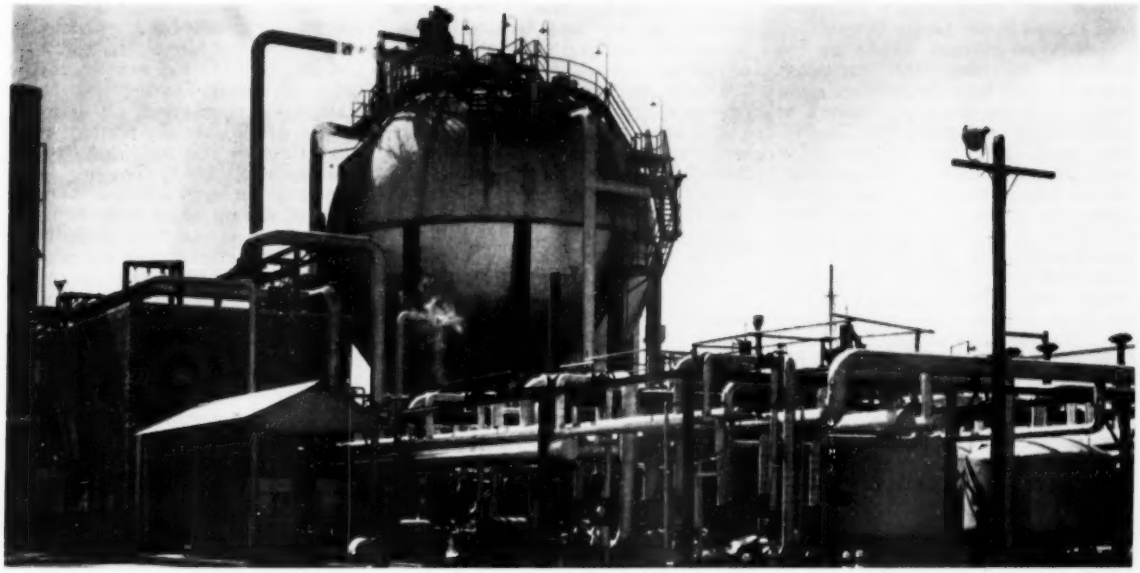


Fig. 3. Completed water softening plant at Bayway Refinery presents neat and striking appearance. All piping six inches in diameter and larger was fabricated in the shop with automatic welding equipment. This held field welding to a minimum, assuring a cleaner appearance and good, dependable joints throughout

enough to provide access for installation and maintenance.

Equipment and Operation

Because practically all of the piping involved in connection with the water treatment plant is in the open, it was possible to design and install a very compact and well-balanced system of piping. All piping 6 in. and larger was fabricated at Dravo Corp.'s Marietta, Ohio, pipe shop, and as a result of welding being performed by automatic machines, the pipe lines present a very neat appearance.

Design capacity of the plant was set at 200,000 gal per hour of treated water leaving at a temperature of 228 F. This water serves as make-up for the 700 psi, 700 F boilers at the Esso Central and West Side boiler houses. Main equipment requiring piping connections consists of a sedimentation tank, 12 anthracite filters 11 ft diameter by 5 ft high and 6 zeolite softeners 10 ft diameter by 5 ft 6 in. high. The filters were designed for a pressure of 50 psig at 260 F and the softeners for 100 psig at 260 F.

Two lime mixing tanks 9 ft diameter by 7 ft high equipped with motor-driven, propeller-type agitators are housed in the chemical mixing room of the control house. This room also contains one phosphate mixing tank 6 ft diameter by 4 ft 6 in. high and one sulfite mixing tank 2 ft diameter by 3 ft high. A sulfite pump delivering 2 gal per hr at 75 psi head and two lime feed pumps delivering 15 gpm at 150 ft head as well as two phosphate feed pumps of the same capacity are installed in this room near the tanks which they serve.

A sphericone sedimentation tank, 43 ft 6 in. diameter by 60 ft in height, of the continuous hot process lime type, receives raw water through a control valve. This valve, with its guard valves and by-pass, is located on the roof of the control house so that acess may be easily obtained for the adjustment and maintenance. Raw water is delivered to the sedimentation tank by a 3000-gpm pump driven by a 150 hp motor. A standby turbine-driven pump of similar size is so connected that failure of the motor-driven pump will open the steam throttle on the turbine and throw this standby unit into service. Exhaust steam at 10 psig (saturated) from Esso's power house is fed through a butterfly type automatically controlled steam valve into the sedimentation tank. This valve is designed for a maximum steam flow of 225,000 lb per hour.

Motor or Turbine Pumps

Treated water leaves the sedimentation tank through a 16 in. line and is fed to each of the 12 filters through an 8-in. air-operated 3-way valve mounted in front of each filter. These 3-way valves, which are actuated from the control house, are used to control the flow for both normal and backwashing operations. Water is collected from the filters in a 16-in. header and passes into the suction of the 3500-gpm motor-driven treated water pump. A standby turbine-driven pump is provided with the throttle of the turbine arranged to be opened by a pressure-actuated control mounted on the discharge line of the motor-driven pump. Any failure of the motor-driven pump resulting in a discharge pressure drop will then actuate the steam throttle and place the turbine-driven pump in operation.

Discharge from the treated water pumps is picked up by a 16-in. header and distributed to each of the six zeolite softeners. Each softener receives water through a 10-in. air-operated gate valve and discharges it through another 10-in. air-operated gate valve. A 6-in. air-operated gate valve controls the discharge to the sewer and a similar valve controls the backwash water which is returned by an 8-in. header through a control valve to the sedimentation tank. All of these air-operated valves are actuated from the control house.

Backwash Control

Lime mixing tanks receive water from a condensate storage tank and discharge the lime solution to the sedimentation tank through 15-gpm feed pumps, one of which is a standby. These pumps are driven by 5 hp motors and operate against a 150-ft head. Flow is regulated by a control valve controlled by the flow through the 16-in. raw water header. Sulfite and phosphate are delivered by similar pumps directly into a 20-in. header from two existing low pres-

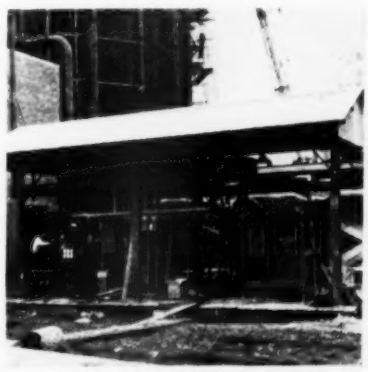


Fig. 4. Switches and motor starters are located under shelter, connected to underground conduit

sure heaters which supply the boiler feed pumps in the power house.

Adequate pressure exists at the softeners to force the backwash water directly into the sedimentation tank; it is necessary, however, to pump backwash water from the filters back into the sedimentation tank. This is done by a 50 hp motor-driven pump having a capacity of 1500 gpm against a maximum head of 100 ft. A standby turbine-driven pump is provided and arranged with control similar to that on the treated water turbine-driven pump so it will cut in on failure of the motor-driven unit. Backwashing of the filters and backwashing and regeneration of the softeners is controlled from the panel board in the control room. These operations can be manual, by using individual switches to control each valve or pump involved in this operation, or can be semi-automatic through use of a timer which puts each vessel through its cycle. Normal requirements call for one filter to be backwashed for 12 minutes every two hours.

Operating Cycle

The cycle of operation of this plant is as follows:

During normal operation treated water from the sedimentation tank will flow through the filters by way of a 3-way valve ahead of each filter. After leaving the filters the water is picked up by the treated water pump and pumped through the softeners and out to its final usage.

During backwash the 3-way valves on the filters will be in a position to block the treated water from the sedimentation tank and cause it to flow through the filter's connecting header back through the bottom of the filter and through the 3-way valve to the backwash pump; from this it is returned to the sedimentation tank. One filter is backwashed for 10 to 15 minutes every two hours. Starting one filter at 8:00 a.m., for example, all 12 filters will be backwashed during a 24-hour period.

The backwash of all filters either is manual or semi-automatic. For manual operation, the operator has switches available to operate each 3-way valve as well as the backwash pump separately. For semi-automatic operation, a 2-position push button switch marked "normal" and "backwash" is provided for each filter. This switch actuates a timer which puts the filter through its cycle. A red signal light under each switch signifies to the operator which filter is in backwash position at any time.

Each of the six zeolite softeners is furnished with four air-operated gate valves. During normal operation two of these valves are open and two are closed. Treated water flows from the filters through the treated water pump into the top of the softeners and out through the bottom to the point of usage. The softener backwash cycle runs about 10 minutes, during which time the treated water runs through the softeners to the sedimentation tank. The regeneration cycle for each softener takes 32 minutes, during which time the backwash pump is inactive while brine and treated water solution are pumped through the softener and out to the sewer. The slow rinse cycle of 30 minutes and the final rinse of 35 minutes follow, the treated water being pumped through the softeners and out to the sewer.

Regeneration Cycle

Regeneration of the softeners is set up for manual or semi-automatic cycling also. Individual switches to control the air to each of the softener valves are located on the control board. Also provided is a push button for semi-automatic operation of each softener. This push button actuates a timer which puts the softener through its cycle. Each softener has a red light under the push button to indicate when the softener is being regenerated.

The complete installation forms a compact and pleasing appearance, has been proved extremely flexible.

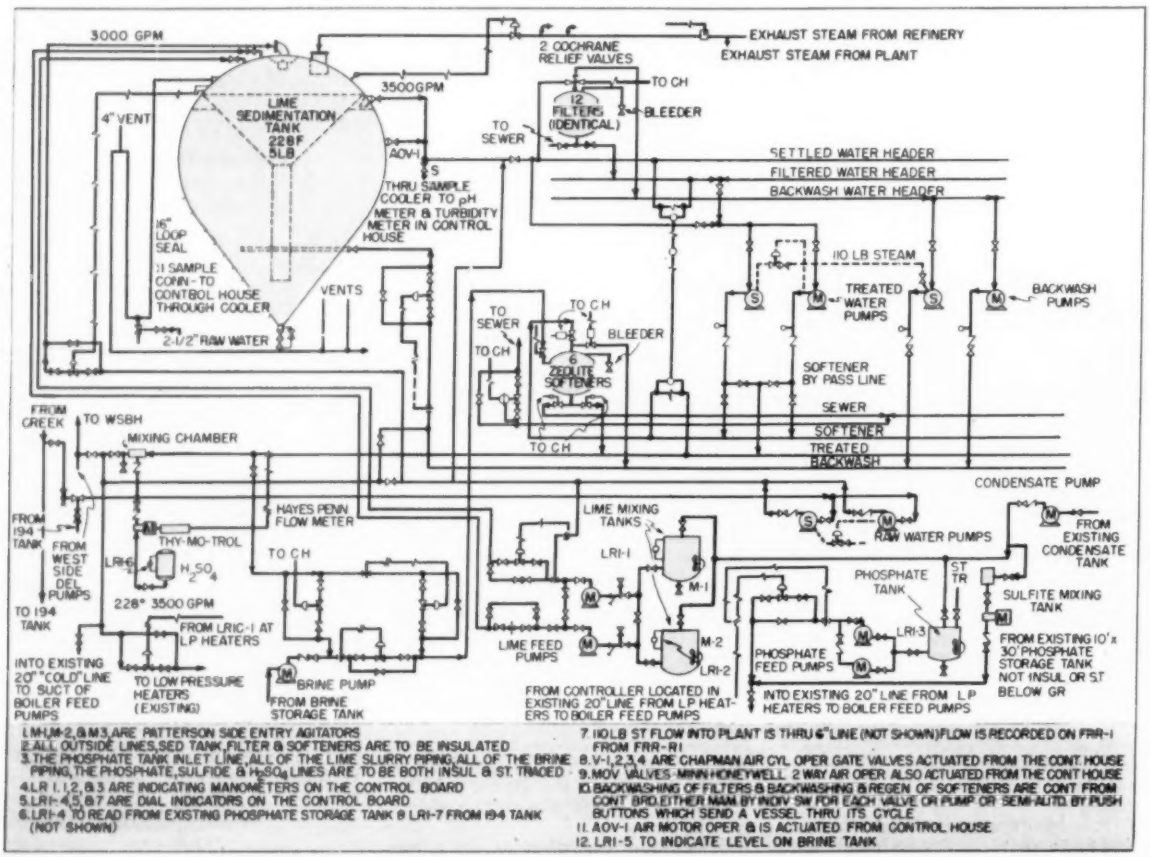

3000 GPM
2 COCHRANE RELIEF VALVES
EXHAUST STEAM FROM REFINERY
EXHAUST STEAM FROM PLANT
3500 GPM
TO CH
12 FILTERS (IDENTICAL)
BLEEDER
4" VENT
LIME SEDIMENTATION TANK 228' 5 LB.
TO SEWER
AOV-1
SETTLED WATER HEADER
FILTERED WATER HEADER
BACKWASH WATER HEADER
THRU SAMPLE COOLER TO pH METER & TURBIDITY METER IN CONTROL HOUSE
16" LOOP SEAL
1" SAMPLE CONN - TO CONTROL HOUSE THROUGH COOLER
VENTS
110 LB STEAM
TREATED WATER PUMPS
BACKWASH PUMPS
2-1/2" RAW WATER
TO SEWER
TO CH
BLEEDER
6 ZEOLITE SOFTENERS
SOFTENER BY PASS LINE
SEWER
SOFTENER TREATED BACKWASH
FROM CREEK
TO WSBH
MIXING CHAMBER
CONDENSATE PUMP
FROM 194 TANK
FROM WEST SIDE DEL. PUMPS
HAYES PENN FLOW METER
THY-MO-TROL
LIME MIXING TANKS
LRI-1
RAW WATER PUMPS
FROM EXISTING CONDENSATE TANK
LRI-6
H_2SO_4
TO CH
M-1
PHOSPHATE TANK
ST TR
SULFITE MIXING TANK
TO 194 TANK
228' 3500 GPM
FROM LRIC-1 AT LP HEATERS
LRI-3
FROM EXISTING 10' x 30' PHOSPHATE STORAGE TANK NOT INSUL OR ST BELOW GR
INTO EXISTING 20" "COLD" LINE TO SUCT OF BOILER FEED PUMPS
TO LOW PRESSURE HEATERS (EXISTING)
BRINE PUMP
FROM BRINE STORAGE TANK
LIME FEED PUMPS
M-2
LRI-2
PHOSPHATE FEED PUMPS
FROM CONTROLLER LOCATED IN EXISTING 20" LINE FROM LP HEATERS TO BOILER FEED PUMPS
INTO EXISTING 20" LINE FROM LP HEATERS TO BOILER FEED PUMPS
1. M-1, M-2, & M-3 ARE PATTERSON SIDE ENTRY AGITATORS
2. ALL OUTSIDE LINES, SED TANK, FILTER & SOFTENERS ARE TO BE INSULATED
3. THE PHOSPHATE TANK INLET LINE, ALL OF THE LIME SLURRY PIPING, ALL OF THE BRINE PIPING, THE PHOSPHATE, SULFIDE & H_2SO_4 LINES ARE TO BE BOTH INSUL & ST. TRACED
4. LR 1, 1, 2, & 3 ARE INDICATING MANOMETERS ON THE CONTROL BOARD
5. LRI-4, 5, & 7 ARE DIAL INDICATORS ON THE CONTROL BOARD
6. LRI-4 TO READ FROM EXISTING PHOSPHATE STORAGE TANK & LRI-7 FROM 194 TANK (NOT SHOWN)
7. 110 LB ST FLOW INTO PLANT IS THRU 6" LINE (NOT SHOWN) FLOW IS RECORDED ON FRR-1 FROM FRR-R1
8. V-1, 2, 3, 4 ARE CHAPMAN AIR CYL OPER GATE VALVES ACTUATED FROM THE CONT. HOUSE
9. MOV VALVES - MINN HONEYWELL 2 WAY AIR OPER ALSO ACTUATED FROM THE CONT HOUSE
10. BACKWASHING OF FILTERS & BACKWASHING & REGEN OF SOFTENERS ARE CONT FROM CONT BRD. EITHER MAN. BY INDIV SW FOR EACH VALVE OR PUMP OR SEMI-AUTO. BY PUSH BUTTONS WHICH SEND A VESSEL THRU ITS CYCLE
11. AOV-1 AIR MOTOR OPER & IS ACTUATED FROM CONTROL HOUSE
12. LRI-5 TO INDICATE LEVEL ON BRINE TANK

Fig. 5. Flow diagram showing points for introducing phosphate, sulfite and sulfuric acid into effluent. Backwash pumps return wash waters to sphericone

Power for the Pullman Laundry

Clothesline for Pullman's yearly wash would go twice round the world. They generate own power in this plant to wash 90,000 pieces a day

PULLMAN COMPANY, world's largest hotel on wheels, furnishes sleeping accommodation for more than 50,000 passengers every night. Before a sleeping car begins a trip, its lockers are stocked with 120 clean pillow slips, 110 sheets, 200 towels and six porter's coats. With 6000 such cars rolling across the country almost continuously, it is easy to understand why their annual laundry bag holds about 34,000 tons of linen.

To do a washing of this size, and have it meet rigid standards of cleanliness, requires a vast number of machines and personnel, tons of soap and water. Actually, the work is done by 46 laundries. Seven of these laundries are in cities where it is convenient to drop-off and pick-up bundles, and are company-owned.

23 Tons of Laundry a Day

One of the seven company-owned laundries, in Chicago, serves eight railroad yards. This laundry handles approximately 90,000 pieces of linen a day — nearly 23 tons. Opened in 1931, the plant originally supplied its own steam, and purchased all electricity required to operate motors, ironers, lights and other laundry equipment.

Several years ago Pullman investigated the economics of generating their own electric power. They found it feasible, and decided on two engine-driven generators. After some searching for the proper equipment, two 400-hp Ames Uniflo engines, with 250-kw, 240-v three-phase generators and self-excited 12-kw, 125-v exciters, were located in Cleveland. They were dismantled and crated, and shipped to Chicago where they were installed in the plant.

Underfeed Stoker Firing

Character of the load in the plant is steady, operating one 8-hr shift per day. To supply required steam two Babcock & Wilcox Stirling boilers, rated at 326 hp each, are operated singly for 60-day periods. The boilers are fired by Detroit underfeed stokers and burn Indiana fines. This coal is burned because of safety in storage — the low sulfur content reduces the likelihood of fire. Delivery is directly from railroad cars on a spur line.

Coal is handled from an outdoor covered storage area to overhead bunkers by a Brady conveyor system which includes one section with a magnetic belt. They collect from the coal almost a bushel of scrap metal every year. Coal is moved from the top of the vertical conveyor into overhead bunkers by a screw feed. It is gravity-fed to the stokers. The two bunkers each hold 75 tons of coal and are gunited on the inside.

Each furnace (472 cu ft) has three overfire steam jets at the front which operate when furnace doors are opened. Jets are also installed in the back bridge wall ready for use, but they have never been found necessary. Average evaporation per pound of fuel averages 8 to 10 lb of steam.

Engines as Reducers

Boiler feedwater is obtained from Lake Michigan. Feedwater is filtered in a sand filter, then fed to a resinous zeolite softener. The plant uses 140,000 gal of water per day. Make-up runs between 5 and 10 per cent. The engines are used as reducing valves. Steam pressure is reduced from 140 psi to atmospheric for washing and other purposes. A Kelly-Patterson feedwater heater of 25,000 gal per hr capacity is used.

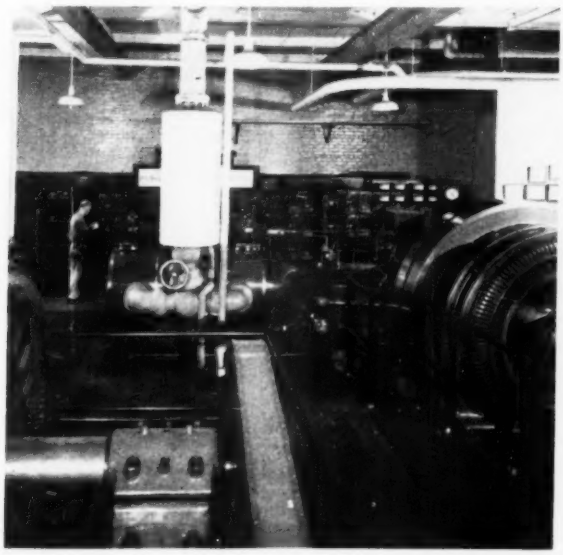


Fig. 1. View of engine room showing switchboard and one Ames uniflow engine

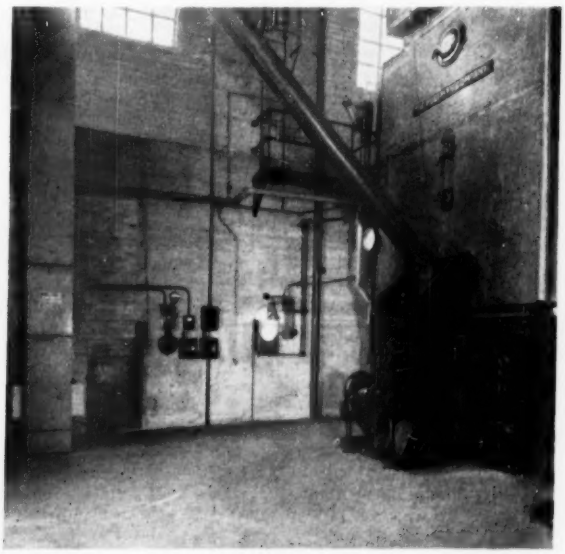


Fig. 2. Vertical conveyor (left) takes coal from outside storage to bunkers

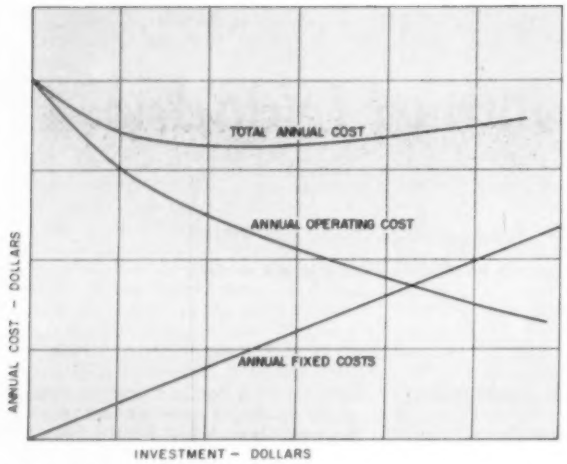


Fig. 1. Relationship of annual fixed costs and operating costs to total annual cost for power boilers (Patterson and Riker, *Combustion*, August 1949)

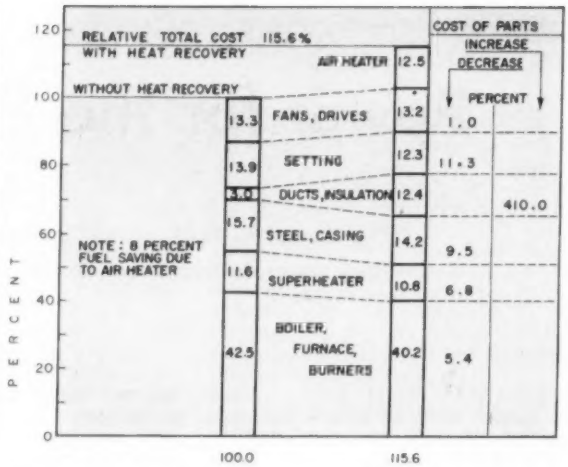


Fig. 2. Chart showing effect of air heater cost on total cost and costs of other power boiler components (Patterson and Riker, *Combustion*, August 1949)

Standardized Industrial Boilers Can Keep Your Steam Costs Down

By CARL E. MILLER
Manager, Industrial Division
Combustion Engineering, Inc.

They can help you get proper balance between investment and operating costs, resulting in lowest over-all total cost. Fuel cost and type of fuel firing very important for effect on long-range planning. Several types of standardized boilers now available, properly designed for gaining greatest advantages in maintenance, efficiency, lower operating costs. Here's how you can gain them

ECONOMIC SELECTION of boilers involves reaching the best over-all balance between investment and operating costs for a given condition. One way to do this is to take full advantage of the manufacturer's designs and facilities through the use of standardized units.

By proper balance between investment and operating costs lowest over-all total cost is attained. Fixed charges are controlled by interest rate and the assumed life of the plant. As they decrease, the optimum point will move in the direction of higher capital investment if operating costs are constant or, if fuel costs increase, higher investment is justified. (See Fig. 1.)

This fact should be emphasized because of its effect on long range planning. Fuel cost should be considered not only on the basis of present source of supply and its cost, but also on the basis of trends in quality, cost and availability. As a modern boiler plant has an estimated useful life of at least 20 to 30 years, the economic analysis of cost should be based on a projected average figure rather than the present market price. This may have a considerable effect on the choice of fuel-burning equipment and amount of heat recovery equipment.

The more important items affecting capital cost of the boiler unit are size of unit, type of firing, amount and type of heat recovery, dust collection and other auxiliary equipment. In most industrial plants, operating pressure and temperature are also important, but in district heating plants this is less important, as most of the steam generation is at low pressure.

How Many and How Big?

Number and size of boilers is one of the first items to be considered. Although one large boiler will cost less than several smaller boilers, minimum investment is not always the controlling factor. Selection of the number of boilers and total installed capacity in relation to peak demand is the basic approach, but one must also consider other variables such as peak demand, load factor, equipment availability, conservatism in equipment design, possible increases in peak demand, and plant location.

Use of standardized designs is gaining more and more recognition as a means for reducing both fixed and operating costs. It is a means of reducing capital investment by decreasing engineering and production costs of the manufacturer, at the same time utilizing proven designs with their advantages in maintenance, efficiency, and lower operating costs. The biggest handicap to standardization in boiler plants is the common human weakness of personal prejudices and preferences.

In some ways the boiler manufacturing business is comparable to high grade men's custom tailoring establishments. It is possible to buy a

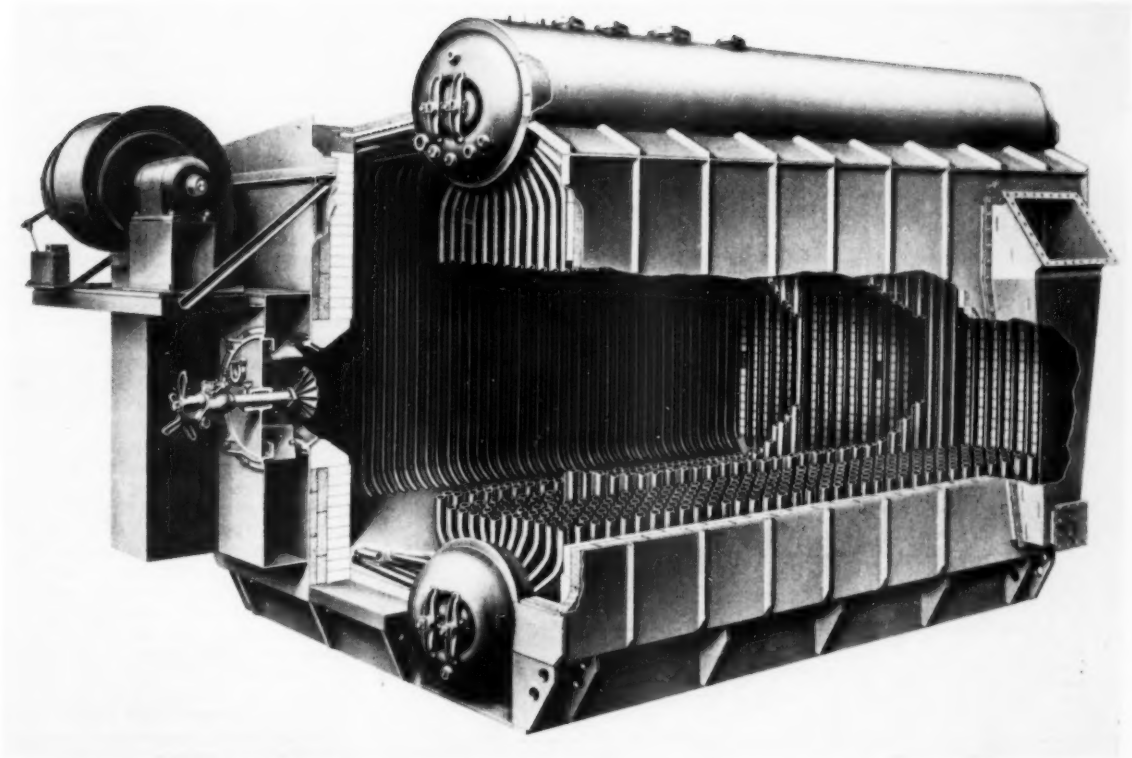


Fig. 3. Here is one of a standardized family of shop-assembled units, for oil firing, Type VP, available in capacities from 4000 to 30,000 lb of steam an hour.

ready-made suit that is well made and can be fitted to an average individual with only minor alterations. Also, it is possible to buy a suit of a general pattern but specifically tailored to an individual's order. The first exemplifies certain boilers which have been completely standardized but which are generally available only in smaller capacities. The second is comparable to standardized *types* of boilers built along certain general patterns and available in practically all capacities and pressures, with many of the component parts completely standardized. The foregoing factors and those to follow were discussed by the author in a paper before the 1953 annual meeting of the National District Heating Association. This is a condensation of that paper.

Fuel Choice Important

However, in any design the choice of fuel is most important, particularly as between coal and oil or gas. If coal is to be burned, the ability to use finer sizes and higher percentages of ash should be carefully evaluated. In some areas, even though gas or oil is to be used initially, the design is such that a future conversion to coal firing can be made if a change in fuel prices warrants such a step. In such cases the basic design is the same as if coal were the original fuel.

If oil or gas only is to be considered, a much simpler and lower cost furnace and boiler arrangement is possible. Because of the lessened slagging problem, the furnace itself can be smaller and the boiler tubes can be more closely spaced and baffled. No equipment need be provided for removing ash from the furnace and soot blower and dust collector equipment is minimized. These factors contribute to a lower cost design.

On the other hand, there are indications that much of the future oil will be supplied from foreign sources with a resultant increase in scale-forming and corrosive elements over what has been experienced with domestic supplies. Such fuel requires wider-spaced tubes, provision for washing, and reasonable control of temperature at the cold end of the air heater.

The question of providing or omitting heat recovery equipment is also important. The lowest cost type of heat recovery equipment is an air preheater. (See Fig. 2.)

Oil and Gas Fired Boilers

One of the smallest truly standard steam generators is a compact oil-fired forced-circulation unit originally designed to supply steam for car heating on diesel-propelled trains, but adaptations of this design are now available for industrial plants requiring small quantities of steam. This unit has automatic push-button start and stop control and can generate up to 6000 lb per hr at 300 psi from a cold start in a few minutes.

The next size and the second in the standard family is a shop-assembled unit available in capacities from 4000 to 30,000 lb per hr. Figure 3 illustrates its general arrangement. Its principal features are compactness, lower cost per pound of steam because of savings from shop assembly and standardization, pressure firing, virtual elimination of all refractory, ability to burn residual oil, high efficiency and automatic operation. Units of this type are receiving wide acceptance in industry.

Figure 4 is a design that is adaptable to complete standardization in the smaller sizes and to standardized components in the larger units. It can be completely standardized in capacities up to 100,000 lb per hr. Above that, the number of variations in pressures and temperatures, space conditions, and amount of heat recovery required make it generally desirable to assemble the unit from a number of standardized components and thus it is classified as a standardized *type* of boiler.

Coal-Fired Boilers

There are many kinds of completely standardized coal-fired boilers in the lower capacities. Most of the variations are the result of modifications required by different types of firing equipment. Figure 5 illustrates one which has received wide acceptance, a reason for its popularity being that it is adaptable to any type of firing. The particular design shown is a 2-drum boiler with a baffled con-

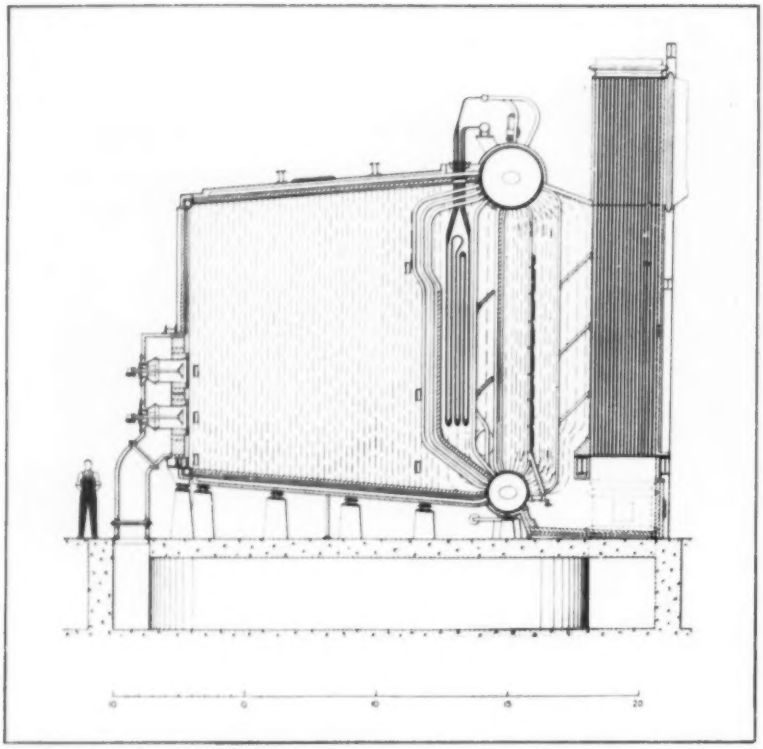


Fig. 4. This is the Type VU boiler, completely standardized in smaller units, adaptable to standardized components in larger units. This design completely standardized on units up to 100,000 lb per hr

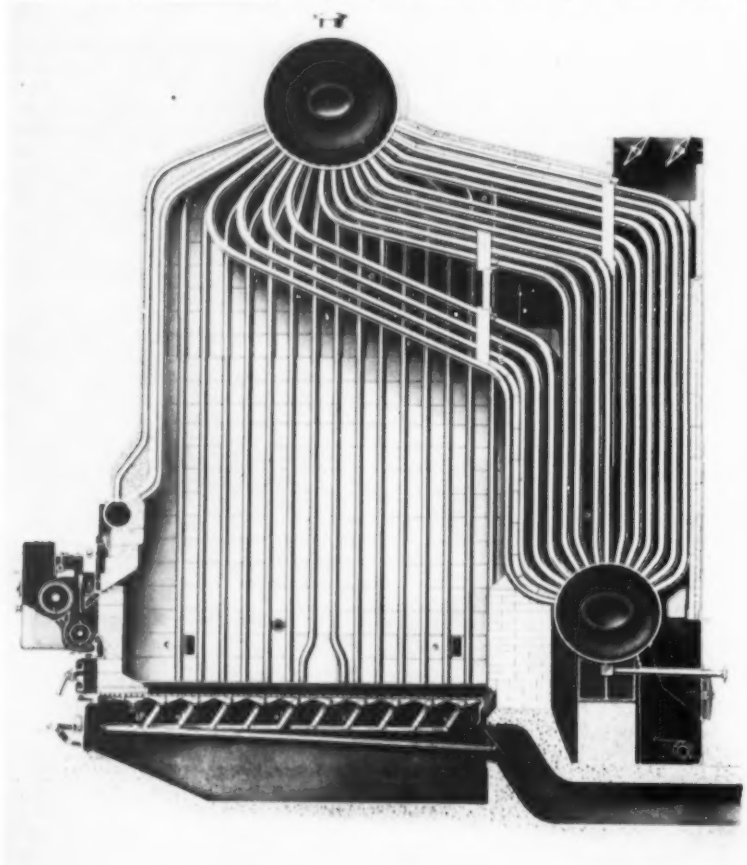


Fig. 5. Completely standardized VU-10 boiler, especially for coal firing with spreader stoker but readily adaptable to any type of firing

vection bank and a water-cooled furnace fired with a spreader stoker. This design can be built economically in sizes from about 10,000 to 60,000 lb of steam per hour and within this range has the definite advantage of being adapted to firing by oil or gas, or by anthracite or bituminous coal.

As capacity increases, the general design of the furnace and boiler must change in order to take full advantage of the various types of coal firing equipment. In the stoker-fired units, these designs fall into three general classes: (1) spreader; (2) traveling grate with open furnace; (3) traveling grate with a rear-arch furnace.

The traveling grate with a rear arch is not widely used, but does have definite advantages for certain fuels. It is particularly adaptable to burning fine sizes of free-burning coals, such as the anthracites and lignite.

When higher volatile, free-burning coals are to be burned on a traveling grate, some saving in initial cost can usually be made by using an open-type furnace rather than the rear-arch design. The volatile in such fuel is sufficient to give reasonable ignition characteristics by providing a short front arch. Adequate mixing of the volatile at the front arch is important and is accomplished by providing high-pressure air jets through the arch to supply additional combustion air and to create turbulence.

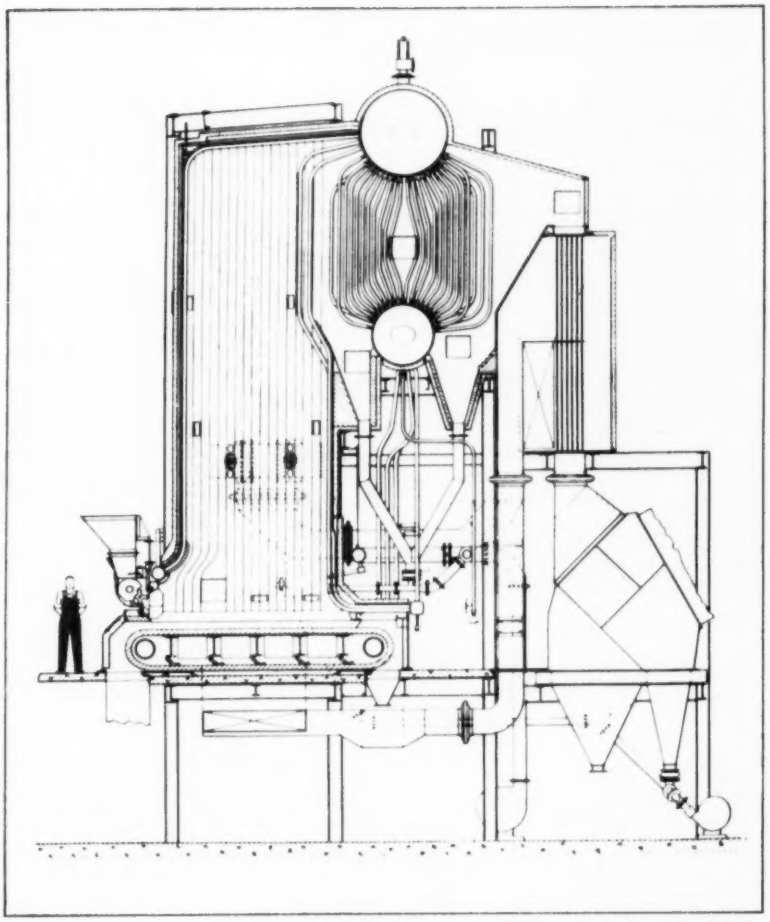
Spreader Stokers

Both of the traveling grate designs have advantages from an operating standpoint, and in some areas this type is the only satisfactory answer to proper burning of the available coals. On the other hand, there has been an enormous increase in the popularity of the spreader stoker during the last few years, the principal reason being that a steam generator fired with a spreader stoker can be manufactured at a lower cost per pound of steam delivered.

Offhand this statement would not seem reasonable, for the larger spreaders use a traveling-grate mechanism and have feeder units which add to the cost. However, the overall cost of the spreader-fired unit is lower than the traveling grate, because it is possible to operate the spreader at higher burning rates and therefore a smaller grate can be used. This is reflected in the cost not only of the stoker but also of the furnace and boiler unit, itself.

Figure 6 shows a similar arrangement in the lower capacity range. It has the additional advantage of auxiliary firing of oil through the use of tangential burners. With such burners, an intimate mixing of the fuel and air is assured within the furnace in a minimum of time. This makes it possible to set the burners higher in the furnace, giving better

Fig. 6. Here is one of the standardized baffleless type VU boilers with combination oil and spreader firing, in the lower capacity range



protection to the grate and assuring complete combustion before the gases enter the convection bank.

A discussion of spreader stoker firing would not be complete without some mention of the spreader units, themselves. Over the years many improvements have been made in the basic design. Two recent ones are the elimination of line shafting and the use of an individual drive on each coal feeder.

Line shafting has always been a source of maintenance in any location. On a boiler the situation is aggravated because of the exposure of the line shaft, bearings and clutches to heat, and the difficulty in keeping the various parts in alignment. Intermittent coal feed, particularly at light loads, has sometimes given unstable furnace conditions and a tendency to pulsate and smoke. During the past four years, developments have resulted in a spreader unit with an integral drive and continuous coal feed.

Hot Water Heating

It is appropriate to mention briefly recent developments in the use of high-pressure, high-temperature water for central heating. The application is a parallel one to the use of steam, although the economics seem to limit the application of high-temperature water to highly concentrated areas. Most of the recent applications are those engineered by the Army Air Force. They are using high-temperature, high-pressure hot water for heating facilities such as hangars, shops, miscellaneous auxiliary buildings, and aprons in front of the hangars.

Figure 7 illustrates a typical boiler designed for such use in a high-pressure, high-temperature hot-water system. This is radically different from previous designs discussed, due primarily to the fact that a controlled-circulation type of boiler has been used instead of natural circulation.

Its features include a completely water-cooled radiation section (furnace) which employs $1\frac{1}{2}$-in. tubes on close spacing (sidewall $1\frac{5}{8}$ in., rear wall and front wall 2 in.). This permits a thin wall setting construction with inherent savings in setting costs and weights. The positive circulation in the tube circuits permits higher furnace heat release rates and controlled circulation is obtained with only 10-psi drop through entire unit.

The tubes in the convection section are extensions of the front, rear and sidewall elements, simplifying the circulation and making a more compact unit. Moreover, its single-pass convection section has a low-draft loss, reduces erosion when burning coal, and utilizes the minimum number of soot blower elements.

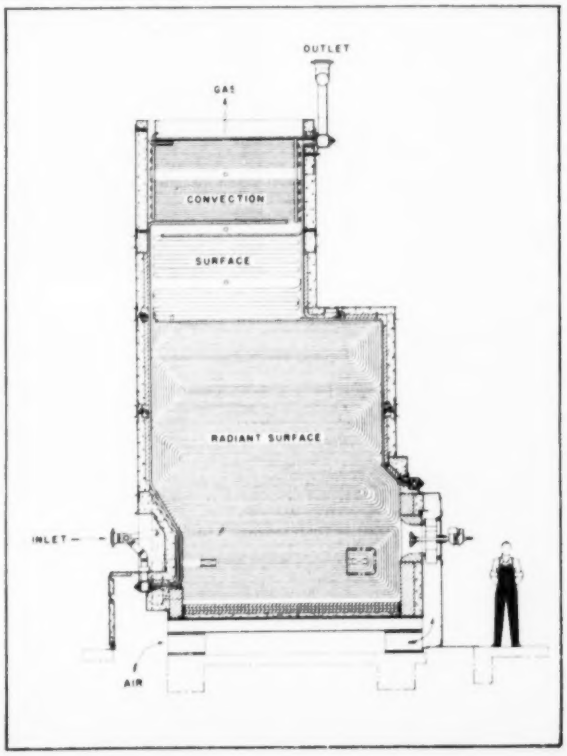


Fig. 7. For hot water heating systems, this high-pressure, high-temperature boiler supplies hot water, has controlled circulation, completely water-cooled radiation section, high furnace heat release, low weight, low draft

Oak Creek's "Fair-Weather" Slip Saves Money, Speeds Coal Handling

BREAKWATER costing a couple of million dollars and thus causing water transportation to the new Oak Creek power station of the Wisconsin Electric Power Co., south of Milwaukee, to be of questionable economy, was omitted by the adoption of the following procedure:

1. Whenever the weather is unfavorable, by-passing Oak Creek and continuing northward to the Port Washington power plant for unloading of ships carrying midwestern coal from South Chicago.

2. Using self-unloader ships that divest themselves in four to five hours, thus minimizing chances of unpredicted weather changes.

3. Turning the ships around before entering in order to permit quick departure in case of unexpected sudden high winds, making handling hard in narrow slip.

The photographs on these two pages show in detail exactly how the docking of a self-unloader is carried out. The ship is guided into a dredged turning basin by radar buoys and brought alongside of a turning pile by means of which the ship is pulled, stern end first, to the unloading dock. The procedure is simple, quick, and effective; and, as indicated above, it made unnecessary the construction of an expensive breakwater. The 810,000-sq-ft dock built into Lake Michigan has a storage capacity of 1,000,000 tons of coal.

The first of the four 120,000-kw generating units to be installed at Oak Creek has just gone into operation. When the four units are completed, they will burn about 1,500,000 tons of coal a year.

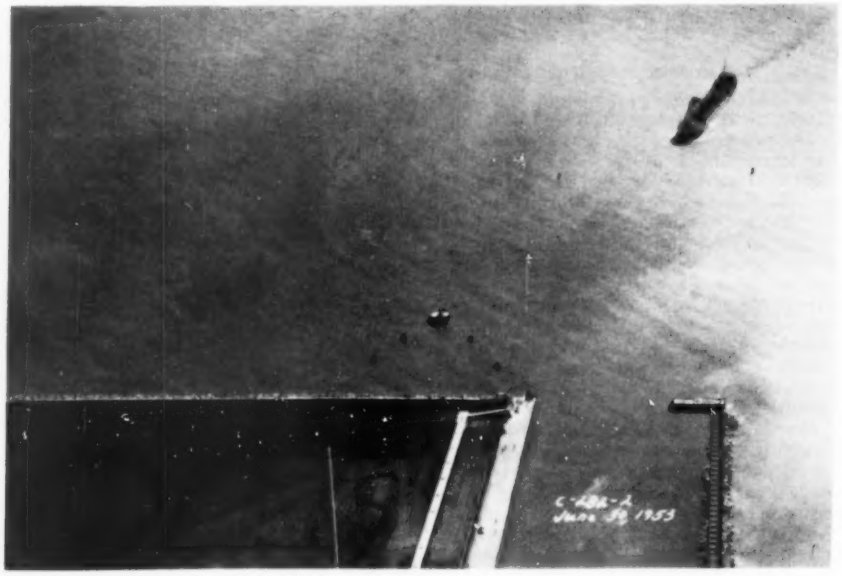


Fig. 1. This view shows one of self-unloader coal vessels coming into turning basin. Ship is almost opposite the radar buoys which mark the entrance to the dredged turning basin. In center of basin is the 35-ft diameter pile against which the ship turns about its center

Fig. 2. The difficult-to-control bow is reliably tied to the turning pile with the aid of a plant employee who is called by ship-to-shore phone and who rides a motored cable car. In cold weather, ice on the cable will be removed by electric heating so the car will operate under all conditions

Fig. 3. Turning operation is hastened by a stern mooring line winched and secured to a towing hook on the dock. Now the vessel will be pulled, stern first, alongside unloading dock shown in Fig. 4

Fig. 4. Thirty minutes after arrival of the ship at turning pile, conveyor boom is started outward. Water ballast needs to be transferred to the opposite side of the ship to maintain level keel while unloading

Fig. 5. Here the ship is shown moored to the unloading dock, and with the boom delivering coal to the dock. Three-fourths of the coal gravitates directly into an underground conveyor. One quarter, for the three winter months of non-navigation, needs be moved an average distance of only 200 ft.

Handle Your Chlorine Cylinders Safely

Chlorine, like explosives, acids, and other dangerous substances, is quite safe when it is properly treated. Here's how to handle it safely

CHLORINE, from the Greek "chloros", meaning green, was used as a lethal weapon in World War I, and since then has been widely used in the power industry for a variety of jobs from water purification to killing clams and mussels on concrete intake tunnels. When we consider the increasing emphasis on safety in recent years, and the fact that chlorine is just as deadly as ever if allowed to escape, its present use may seem surprising.

Why Chlorine Is Used

There are two reasons why chlorine continues to be used in such large quantities. First, it is one of the cheapest and commonest of the strong oxidizing agents, and we put up with its difficulties and dangers because it does certain jobs quicker and better than any substitute. The second reason is that, though it is dangerous if wrongly used, if properly handled it is as safe as any other piece of equipment.

This article outlines the precautions to be observed for the safe handling of chlorine in the containers in which it is commonly used by modern industry.

Properties of Chlorine

Liquid chlorine is a clear amber fluid, 1½ times as heavy as water; gaseous chlorine is about 2½ times as heavy as air, and when present in high concentrations, it can be seen as a greenish gas. Chlorine is neither explosive nor flammable. The least detectable odor is 3.5 parts of gas per million parts of air and the least amount of gas required to produce poisoning after several hours of exposure is only one part of gas per million parts of air. This shows how important it is to make sure there are no leaks of chlorine gas, because people can be poisoned without realizing they are breathing the gas at all.

Chlorine is usually handled in 100- or 150-lb steel cylinders, or in one-ton containers. These containers are usually owned by the chlorine producers or the distributors, and although container sizes are not quite standard, a 150-lb cylinder is usually 10 to 10½ in. diam and 48 to 50 in. high and weighs from 122 to 125 lb. The 1-ton containers have a diam of about 30 in.; they are about 18 in. high and weigh from 1250 to 1600 lb each. The 150-lb cylinders are usually fabricated from hot forged or seamless pressed steel and are tested at 500 psi.

Safety Devices

Each cylinder is equipped with a brass or bronze Chlorine Institute standard cylinder valve with a fusible plug designed to melt between 150 and 155 F. There is one valve per cylinder and this must be protected at all times with a steel cap except when chlorine is being removed from the cylinder. A special wrench is used to open and close the needle valve and outlet cap. The outlet from the valve has a special thread protected by a cap to prevent the accidental coupling of a chlorine

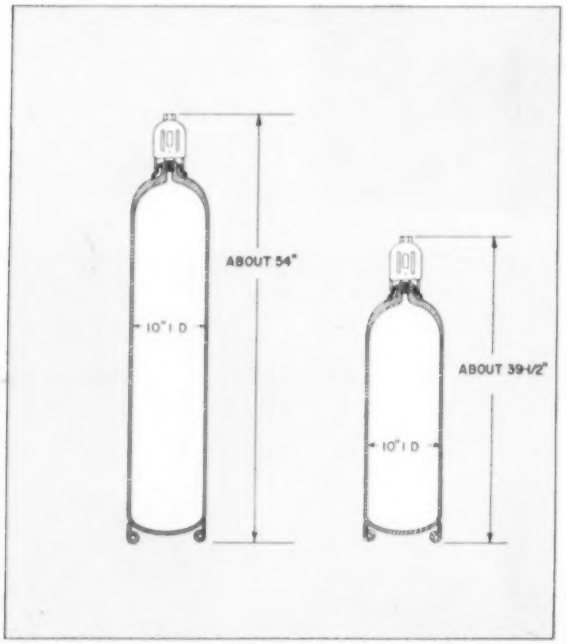


Fig. 1. Average dimensions of commonly used 100- and 150-lb cylinders

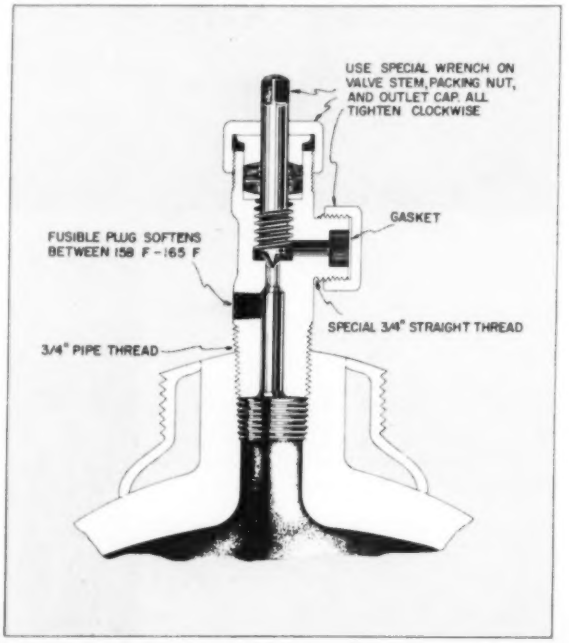

USE SPECIAL WRENCH ON VALVE STEM, PACKING NUT, AND OUTLET CAP. ALL TIGHTEN CLOCKWISE
GASKET
FUSIBLE PLUG SOFTENS BETWEEN 150 F - 165 F
SPECIAL 3/4" STRAIGHT THREAD
3/4" PIPE THREAD

Fig. 2. Section of standard chlorine cylinder valve with poured fusible plug

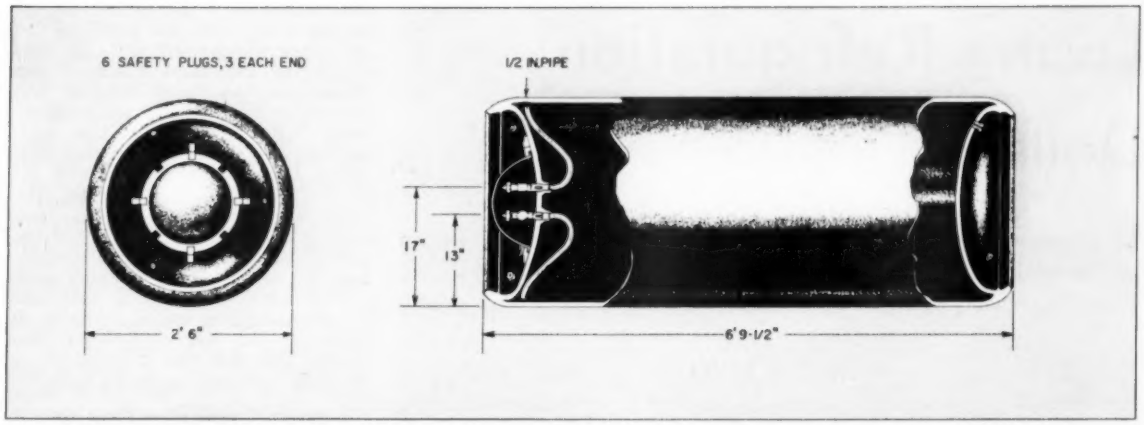


Fig. 3. One-ton chlorine cylinder. With valve arrangement as shown, liquid chlorine is drawn off from the top valve, gaseous chlorine from the bottom one

cylinder to some piping system that is not meant to carry chlorine.

The 1-ton containers are made of welded steel, and each end is dished to form a chime which provides a substantial grip for the hooks used on the special lifting bars to move them. Figure 4 shows details of one of these lifting bars. Each 1-ton container has two brass or bronze valves of the same type as used on the 150-lb container. It will be seen from Fig. 3 that when the cylinder is lying on its side, which is its normal position in storage, liquid chlorine will be drawn out of the top valve and gaseous chlorine from the bottom one.

Handling Instructions

Very complete instructions for the safe handling of industrial chlorine are given in the Chlorine Manual, published by The Chlorine Institute, Inc., 50 East 41st St., New York 17, N. Y. The instructions are too long to be given here in full, but here are a few of the main points to be observed:

Always handle cylinders with care. The smaller ones may stand upright; the 1-ton cylinders are usually stored on their sides. Chlorine cylinders are best kept about 50 to 100 F. There is no harm in storing them outside, but as the pressure of the gas increases with temperature, exposing them to the sun increases the pressure, which may be objectionable. In very hot weather it may be as high as 150 psi, while in cold weather it may be as low as 40 psi. The pressure in the container keeps the chlorine in liquid form and when the valve is opened some of the chlorine passes off as a gas.

Under no circumstances should the cylinders be heated to accelerate gas withdrawal. Masks need not be used when the cylinders are changed, but one should be kept handy and in good condition in case it is needed for emergencies.

Chlorine leaks can be located by holding an open bottle of ammonia near the place where the leak is suspected; the ammonia reacts with the chlorine to produce white fumes. Leaks should be stopped at once as chlorine is not only corrosive but, if inhaled long enough, is poisonous.

Canister gas masks of a type approved by the U. S. Bureau of Mines for chlorine service should always be readily available where chlorine is being stored or transported or used. Gas masks should be located outside the probable area of contamination so that it will always be possible to reach them in case of emergency. Where chlorine is used over a wide area, masks should be available in several places.

Gas masks of the canister type do not supply oxygen; they merely absorb the chlorine present in the atmosphere, leaving air that is clean enough to breathe. Where the chlorine content of the air is greater than 1 per cent, a self-contained oxygen breathing apparatus, or a fresh air hose mask should be used. All personnel who may have to use masks in an emergency should be properly instructed and required to practice their application and use.

This article is based on information supplied by N. C. Stratton, of Gilbert Associates Inc.; J. M. Spencer, of Dundalk, Md., and The Chlorine Institute.

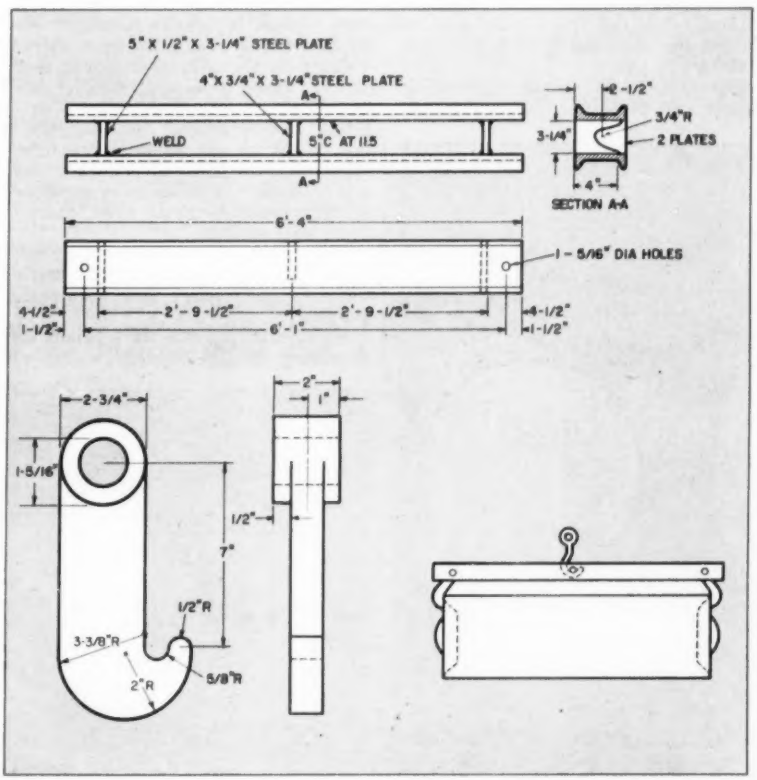


Fig. 4. Shows dimensions of lifting beam and steel hook for 1-ton cylinders, with method of using beam

Losing Refrigeration Dollars This Way?

Recent plant investigation showed money being wasted by several bad conditions, small by themselves, but adding up to large losses. Same faults in your own installation may be costing you money

By C. T. BAKER

Consulting Engineer

RECENT ENGINEERING investigation of the refrigerating and boiler plant of a fairly large meat packing and processing establishment disclosed such wasteful practices that I have been prompted to develop this case history in the hope that other readers will be alerted to the losses that stem from laziness and ignorance.

High Power Bills

Management complained of high power bills and dangerously high temperatures in the various coolers and the storage room.

There were two reasons for the high condensing pressures: 1. Dirty condensers, and 2. Air in the system. Merely cleaning the condensers reduced the condensing pressure from 230 to 215 psi.

As there was ample condensing water and plenty of capacity in the condensing water pump, it seemed logical to look for air. As it turned out, the system was so full of air that a week of purging was required to lower the condensing pressure to 200 lb. A very good purger had originally been installed, but before it would work as it should it had to be completely overhauled.

In searching for the cause of the air in the system, it was found that during the winter of 1942-43 several new cooling coils, along with liquid and suction lines, had been installed in two rooms so that lower temperatures could be maintained during the peak loads which occurred in July, August and September.

After installation, the new coils were placed in service without the air first being evacuated from them. Volume of the several hundred feet of 2 in. diam. pipe and considerable new suction line was large — sufficient to trap several hundred cubic feet of air at atmospheric pressure. Naturally, the effect of this condition was to boost the condensing pressure to dangerous heights, even during light load periods.

This condition has been corrected, but the process consumed many days in both hand and automatic purging.

Failure to provide an efficient oil separator on the discharge line of the compressors permitted all oil carried over from the crankcase of the three compressor units to pass on to the condenser where it was drained to the liquid receiver and ultimately reached the evaporating coils. Only one or two of the evaporating coils in the refrigerated rooms had been provided with oil drains, so that oil reaching the evaporator remained there, thus greatly reducing the capacity of the unit and making it difficult to maintain the desired room temperatures.

This condition is being corrected by the addition of a suitable oil separator on the compressor discharge line and the installation of oil drain connections on all coils.

Novel Condenser Purging

The horizontal, multi-pass shell and tube condenser is located near the atmospheric cooling tower which handles the condensing water. A purge valve had been placed on the top of the condenser shell, with a hose extending from the valve outlet to the basin of the cooling tower, the idea being that with this valve partially opened, the system would ultimately be freed of air. The only thing accomplished by the execution of this brilliant idea was that the condensing water tended to become saturated with ammonia and, of course, raised the pH high on the alkaline scale, providing an excellent solution for reacting on pump impellers, brass bodied valves and galvanized piping.

Naturally, this novel method of purging has been dispensed with.

Hide Curing

Building where hide curing operations are performed is located some distance from the main building. It is equipped with a 4 in. x 4 in. compressor which operates at 300 rpm and it has a separate cooling tower and pump for handling the condensing water. As the temperature required in the hide cellar is not low (50 or 60 deg), it follows that a high suction pressure can be carried on the cooling coils and still provide plenty of temperature difference between the evaporating

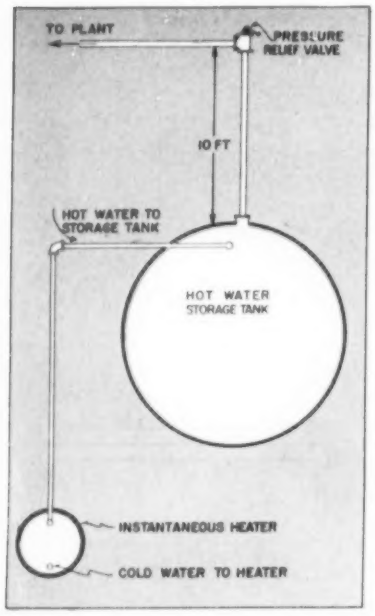


Fig. 1. With heavy flow, safety valve so far above tank may not work when tank pressure is dangerous

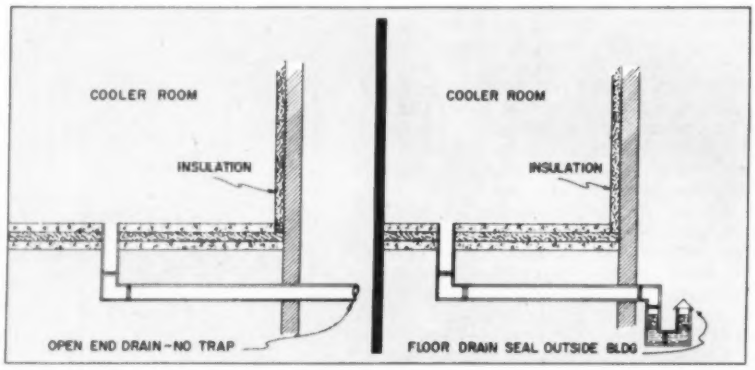


Fig. 2. Cold air escaping through drain (left-hand sketch) was replaced by warm air which caused excessive frosting and reduced efficiency. Condition was cured by adding seal shown in right-hand sketch

refrigerant and the room temperature.

Complaint was made that the compressor was not large enough for this work, but, upon investigation, it was found that cooling was done at a suction pressure of only 10 lb gage, corresponding to a temperature of minus 8.4 F. As the room was liberally piped, it was easily possible to raise the suction pressure to 38 or 40 lb and still have ample temperature difference between the evaporating refrigerant and the room to maintain the required temperature.

Loss of Hot Water

Condensate from a number of steam traps in use throughout the plant was collected in an elevated water storage tank vented to the atmosphere. From this point, the condensate was pumped to whichever of the two installed boilers was in use. Due to a defective float, which failed to close off the make-up water supply when the water level in the tank had reached a predetermined point, a stream of cold water great enough to reduce the condensate several degrees in temperature continued to flow into the tank. In addition, this caused considerable waste of hot water because the tank constantly overflowed.

Moreover, the tank was not elevated sufficiently to insure that the pumps would handle water as hot as was available at times, and it was too small to prevent excessive wastage of hot condensate during the first hour or two in the morning when the traps were called upon to handle large volumes of condensate.

A tank of much greater storage capacity has been installed and it has been elevated high enough above the boiler feed pumps to prevent flashing at the suction intake. The arrangements before and after improvement are shown in Fig. 4.

In order to recover the heat going to waste from flash steam leaving the condensate storage tank, a shell and tube heat exchanger is being installed. Cold water make-up to the condensate tank will be preheated through a considerable range of temperatures in passing through the shell and around the tubes of the unit through which the flash steam passes and gives up its heat to the cold water.

Hot Water Heating System

For supplying the hot water required for plant operations, a hot water storage tank 144 in. long x 48 in. diam was installed. Instead of the usual internal heating coils, this tank has an instantaneous water heater located outside the tank. Of course, there is nothing wrong with such an arrangement, but there were some things in connection with it that did not constitute good practice.

First of all, a safety valve of unknown vintage was installed on the hot water outlet pipe approximately 10 ft above the storage tank. Under conditions of heavy draw-down of hot water, a pressure drop was undoubtedly created between the safety valve and the tank which, in itself, could have produced a rather dangerous condition. In addition to this, however, the location of the safety valve was such that it was impossible to test it to determine whether or not it was in good operating condition. Furthermore, no thermometer had been provided to indicate the temperature of the water.

The modulating steam valve installed on the steam supply to the instantaneous heater was out of order and during the times when the demand for hot water was low, the temperature of the water leaving this heater was found to be 275 F and above.

Immediate steps were taken, of course, to correct this condition. They included the installation of a pressure-temperature relief valve and a new steam modulating valve to control the steam supply to the instantaneous heater.

The tank and heater manufacturer were in no way responsible for the conditions that prevailed, as the owners had ordered a tank of certain dimensions without supplying many of the essential details that should accompany an order of this kind.

Figure 1 shows how the original pressure relief valve was installed.

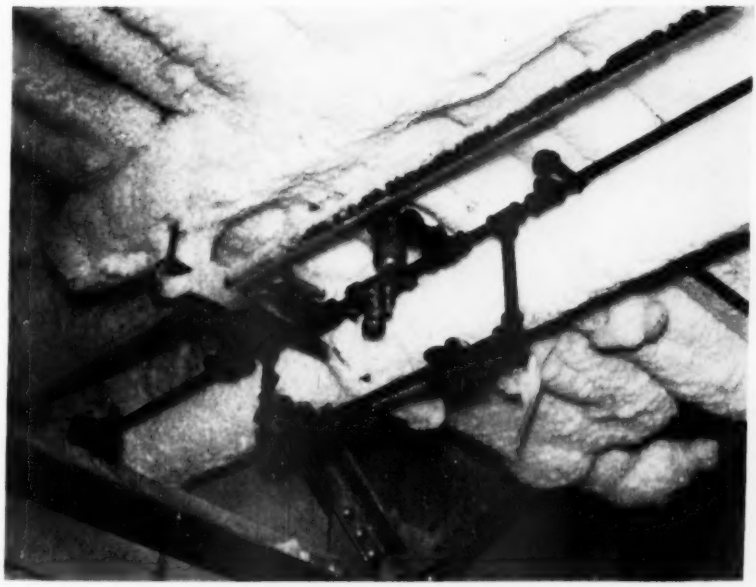


Fig. 3. Bad sealing allows warm moist air to enter refrigeration chamber and cause excessive frosting

Absence of Traps and Drains

A great deal of difficulty had been experienced with heavy frost accumulations in certain of the storage rooms. Though much was caused

(*Continued on page 102*)

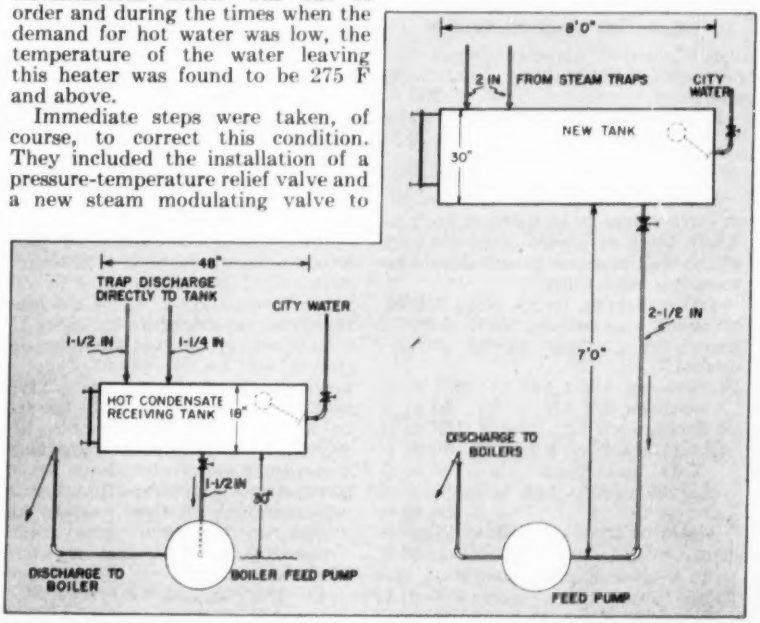
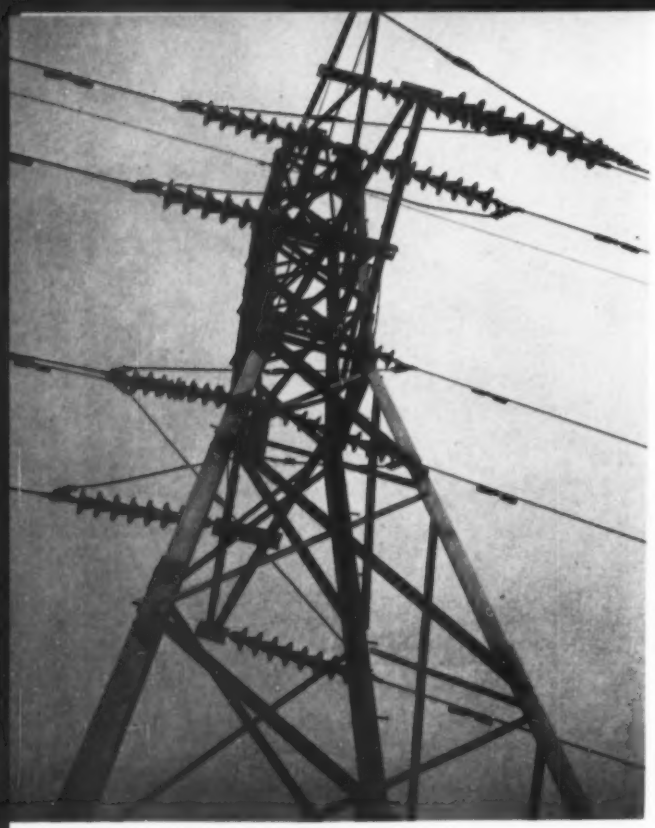


Fig. 4. Flashing at suction intake (left) was cured by raising tank as shown in right hand diagram



Inspection should concentrate on spots where corrosion occurs most easily and where it does most harm, as the bolt areas on this transmission tower

How Much Paint Do You Need?

By L. G. JONES

How to estimate the quantities you need to get a good paint job. To do it, you will need the many useful labor and material costs given here

TO SHOW HOW you should set about estimating the quantity of paint you will need for a particular job, we will start with the example of a typical simple plant office building. It has to be painted inside and out with the type of paint that is suitable for each particular surface comprising the entire job.

Exterior Wall Surface

a. Measured distance round the perimeter of the building: front, back and sides . . . . . 200 ft

b. Average vertical height of walls to be painted . . . . . 22 ft

Total outside wall area (a x b) 4,400 sq ft

If the four walls vary considerably in surface area to be painted, such as where brick or stucco comprise part of the wall area, each wall should be measured separately.

c. If windows, doors, glass bricks, or other non-painted areas form a sizable area, these should be deducted:

24 windows, 4½ x 4 ft . . . . . 432 sq ft
5 windows, 3 x 4 ft . . . . . 60 sq ft
4 doors, 6 x 7 ft . . . . . 168 sq ft
Glass brick front 5 x 12 ft . 60 sq ft
Total deductions . . . . . 720 sq ft

d. Net outside wall to be painted 3,680 sq ft

e. Gable area: span times ½ gable crown height, for this building; 40 ft wide with 5 ft gable height: 2 end gables . . . . . 200 sq ft

f. Added areas of porches, porch trim, extras, etc. . . . . none

g. Total measured wall surfaces 3,880 sq ft

h. Added 10 per cent for contingencies, trim, under edges of siding boards, cracks, places where paint cannot be brushed out, etc. . 388 sq ft

Total surface calculated for outside paint coverage . . . . . 4,268 sq ft

The roof area to be painted is computed from the perimeter wall measurements plus overhang, if any. To this must be added the increase due to the pitch of the roof gable, if any, as well as extras. Pitch is the height of top center line of gable divided by half the span or plan width of the building; in this case, 5 ft height divided by ½ of 40 ft equals ¼ pitch.

Roof Area

Determining the quantity of paint required for the roof is an excellent example of the advantages of empirical computation. If we calculate the paint requirements by using the hypotenuse of the roof triangles, the results will be far short of actual needs, as Table I emphasizes. It is seldom practical to climb to the roof to measure the exact length and width of a sloping roof; so painters, using their experience, have set up some simple estimates that are accurate enough for their purpose and which can be based upon ground measurements. They are shown in Table I.

For the building we are considering, which measures 40 ft x 60 ft with ¼ pitch, the roof area to be painted would be estimated, using the National Paint Association method:

$40 \times 60 \times 1\frac{1}{4}$ equals 3,000 sq ft

Room Surfaces

Easiest way to estimate paint required for inside walls, ceilings and floors is to measure them directly and subtract the areas of windows, doors, cupboards, etc., that do not receive the wall paint.

For the building we are considering, the total inside wall and ceiling areas added up to 13,600 sq ft, and the area of windows, doors, cupboards, glass brick, etc., added up to 1,203 sq ft, so the total inside wall and ceiling area to be painted came to 12,397 sq ft.

Interior woodwork includes doors, stairs, baseboards, trim, etc. Woodwork requires a semi-gloss finish, compared with the flat non-reflective surfaces usually found in offices, drafting rooms, etc. It requires a different paint, and separate calculations. Doors are usually measured separately, and the baseboards, trim, etc., is assumed to require 10 per cent of the paint needed for the wall area. In our building, the doors added up to 1,176 sq ft and the 10 per cent of the total wall area came to 880 sq ft; so the total interior woodwork comes to 2,056 sq ft.

Floors take a special wear resistant coating, in varnish, with or without stain. Hardwood floors may find clear varnishes over primer-sealers more suitable for offices than darkened

Table I. Practical and theoretical requirements compared for roof painting

Pitch of Roof	Practical Estimates: By Means of Calculated Hypotenuse	Lumberman's Association Method	National Paint Association Method
¼	3%	14%	¼
⅓	5%	20%	⅓
½	12%	42%	½
¾	25%	80%	¾

Table II. Estimated requirements of prime coats, finish coats, and trim for one coat of paint on outside surfaces and roofs of different sized houses

Subject	Rooms Average	Size, Feet	Average Height	Paint Requirements, Normal Conditions: Prime Coat	Finish Coat	Trim
House, 1 story	5	30 x 32	12′	3¾ gal	2½ gal	2½ qt
House, 1½ story	6	34 x 36	24	6 gal	4½ gal	3½ qt
House, 2 story	8	36 x 42	24	9 gal	7 gal	1¼ gal
Garage	1 car	12 x 20	10	1½ gal	1 gal	1 qt
Garage	2 car	19 x 22	10	2 gal	1½ gal	1½ qt
			Pitch	Paint	Stain	
Roof		30 x 32	20%	2¼ gal	9 gal	
Roof		36 x 42	45%	4¼ gal	17 gal	

Courtesy. Lowe Brothers Company, Dayton, Ohio.

Table III. Total paint job on plant building, based on data shown in Table V

Location	Type of Paint	Quantity Gal	Price per Gal	Total Paint Cost	Hours to Spread Per Gal	Hours to Spread Total
Exterior	Primer-sealer	17	$3.00	$51.00	1.0 b	17
	Finish	18	4.00	72.00	3.0 b	54
Roof	Stain	40	3.00	120.00	1.0 b	40
	Sealer	15	3.00	45.00	1.0 b	15
Interior	Sealer	62	3.00	186.00	1.0 b	62
	Latex emulsion	50	5.00	250.00	1.5 r	75
Doors, trim	Sealer	10.5	3.00	31.50	1.0 b	10.5
	Enamel	10	5.00	50.00	2.1 b	21
Floors	Sealer	24	3.00	72.00	1.0 b	24
	Varnish	24.0	5.00	120.00	2.7 b	64.8
Totals:		270.5		$997.50		383.3
Labor, at $2.00 per hour estimated average for plant painters:				$766.60		
Paint, 270.5 gal total material cost:				997.50		
Contingencies: Scaffolding, non-painting labor: 20% of labor costs:				153.32		
Overall contingencies of paint and labor: 15% of total:				287.61		
Gross estimate of cost of project:				$2,205.03		

Notes: b = brushed, r = roller applied.
Paint prices estimated as industrial quantity prices.

Table IV. Estimated quantities of paint, varnish and stain required to cover typical ceilings, walls, and floors with one coat of paint in an average house

Room or Area	Size, Feet	Paint Requirements: Ceiling	9 ft Wall	4 in. Woodwork
Bathroom	4 x 6	½ pint	3 pints	1 pint
	6 x 9	1 pint	2¼ pints	1 quart
	9 x 9	1 quart	3 quarts	3 quarts
Bedroom	7 x 9	1 pint	2½ quarts	3 pints
	10 x 13	1 quart	1 gallon	3 pints
	12 x 15	3 pints	1¼ gallon	2 quarts
Kitchen	6 x 8	1 pint	2 quarts	1 quart
	9 x 11	1 quart	3 quarts	3 pints
	11 x 14	5 pints	1 gallon	2 quarts
Living room	10 x 12	1 quart	3¼ quarts	1 quart
	14 x 18	2 quarts	1¼ gallons	2 quarts
	16 x 28	1 gallon	1¾ gallons	3 quarts
	Size, Feet	Paint	Varnish	Stain
Floor or Porch	8 x 11	¾ quart	¾ quart	½ pint
	12 x 14	3 pints	1½ quarts	¾ quart
	18 x 24	3¼ quarts	3½ quarts	2 quarts

finishes. The area to be taken is the full inside plan measurements for the building, regardless of the area taken up by inside walls.

For our building, two floors, each 40 x 60, gives a total of 4,800 sq ft.

Total Paint Requirements

Total paint required for the sample building is tabulated in Table V. The different types of paint for each location are listed in Table III.

Smaller rooms, such as bath rooms, rest rooms, etc., unless large enough to justify separate computation, can be estimated separately from Table IV. Table II is included for rough estimates and checking computations. Table VII is included for quick estimates of maintenance items around the plant.

After some experience by actual painting of special items, such as towers, tanks, transformers, stacks, boilers, pumps, and other standard plant items, tables of requirements for these items can be recorded for quick and accurate estimating. For the same reason, labor costs should be recorded for each job as soon as it is completed.

Gross and Unit Costs

Tables VI and VIII have been prepared to illustrate the development of unit costs per sq ft for each type of surface and paint, labor and materials, for quick estimating. Both material and labor costs include normal extras. All percentages except con-

Table V. Summary of paint requirements for typical plant office building taken as an example in text

Surface Location Type of Paint	Character of Surface	Number of Coats	Net Total Area Sq Ft	Paint Spreading Rate Sq Ft per Gal	Paint Required, Each Part Gal
A. Exterior	Fresh wood		4,268		
Primer-sealer		1		250	17
Finish paint		2		500	18
B. Roof	Wood shingle		3,000		
Stain		2		150	40
Clear sealer		1		200	15
C. Interior walls	Fresh plaster		12,397		
Primer-sealer		1		200	62
Latex emulsion		2		500	50
D. Interior doors, etc.	Fresh wood		2,056		
Primer-sealer		1		200	10.5
Semi-gloss enamel		2		450	10
E. Floors	Fresh wood		4,800		
Clear primer-sealer		1		200	24
Spar varnish		2		400	24

Table VI. Gross labor costs and material and labor costs (without overhead) for one coat per sq ft

		Painting Labor	Scaffolding and misc. 20%	Contingencies 15%	Gross Labor Cost	Estimated Material and Labor Costs
Exterior	Primer-sealer	0.80 b	0.16	0.14	1.10	2.65
	Finish	1.20 b	0.24	0.22	1.66	2.67
Roof	Stain	1.33 b	0.27	0.24	1.84	4.72
	Sealer	1.00 b	0.20	0.18	1.38	3.51
Interior walls	Sealer	1.00 b	0.20	0.18	1.38	3.51
	Latex emulsion	0.60 r	0.12	0.11	0.83	2.27
Interior doors, trim	Sealer	1.05 b	0.21	0.19	1.45	3.75
	Enamel	1.05 b	0.21	0.19	1.45	3.75
Floors	Sealer	1.00 b	0.20	0.18	1.38	3.68
	Varnish	1.27 b	0.25	0.23	1.75	3.56

Notes: b = brush, r = roller application. Scaffolding and miscellaneous percentage estimates vary greatly with the amount of surface covered per move. On steel towers and structural assemblies, the surface area painted is very small per move, and this percentage may exceed 100% of painting labor.

Table VII. Estimated quantities required for one coat of paint to cover miscellaneous small items

Truck (¼ ton)	1 quart
Tractor	1 quart
Automobile	1 quart
Coaster wagon	½ pint
Window, door and frames	1 pint
Work bench (small)	½ pint
Gate (medium)	½ pint
Furnace (medium)	1 pint
2 clothes line posts	¼ pint
Basement stairs	½ pint
Garbage can (med.)	¼ pint
3 picture frames	¼ pint
Door (1 side)	½ pint
Ladder (standard)	¼ pint
Door (1 side)	½ pint
Screen frame	¼ pint
Wire mesh of 8 screens: per side	1 pint
2 shutters, 2 sides	½ pint
Refrigerator (med.)	1 pint
Coffee table (med.)	¼ pint
2 chairs	¼ pint
End table	¼ pint
Dresser (medium)	½ pint
Breakfast table	½ pint
Corner cupboard	½ pint
Canoe	1 pint
Kitchen cabinet (med.)	1 pint
Bookcase (large)	1 pint
Dinette set	1 quart

Table VIII. Estimating costs for materials, without overhead, for applying one coat of paint per sq ft

Location	Type of Paint	Costs in Cents per Sq Ft of Surface, One Coat Only				
		Paint Costs	Thinners Cleaners 15%	Brush Costs 10%	Contingencies 15%	Gross Material Cost
Exterior	Primer-sealer	1.08	0.16	0.11	0.20	1.55
	Finish	0.85	0.13	0.09	0.16	1.01
Roof	Stain	2.00	0.30	0.20	0.38	2.88
	Sealer	1.50	0.23	0.15	0.28	2.13
Interior walls	Sealer	1.50	0.23	0.15	0.28	2.13
	Latex emulsion	1.00	0.15	0.10	0.19	1.44
Interior doors, trim	Sealer	1.60	0.24	0.16	0.30	2.30
	Enamel	1.50	0.23	0.15	0.28	2.13
Floors	Sealer	1.50	0.23	0.16	0.30	2.30
	Varnish	1.25	0.19	0.13	0.24	1.81

tingencies are applied directly to the base paint or painting labor costs.

Normal plant paint work seems to run about 3 cents per sq ft for combined labor and material. Contract estimates run about 5 cents per sq ft for each separate coat. In the October issue of POWER ENGINEERING, figures quoted for painting costs per sq ft ranged from 6.7 cents up to 17 cents, but such high figures were for multilayer coatings, which may comprise three or more coatings. Oil companies estimate maintenance painting at 6 to 7 cents per sq ft.

Extra and Overhead Costs

To the costs mentioned above must be added extras such as surface preparation, sanding rough surfaces, patching cracks, filling holes, removing and replacing hardware, masking windows or non-removable ornaments, and any other services that a good painter generally performs in order to give a perfect job. For metal surface preparation, Pierce placed preparation costs at 17 cents against 15 cents per sq ft actual painting costs. A minimum of 50 per cent of labor costs should be added for average buildings with new surfaces like the one we were considering at the beginning of this article. But for old plant work, 100 per cent of the full painting cost should be added.

Contractors add at least 100 per cent to net costs for overhead. Some utilities and power plants carry fixed overhead charges of about 10 per cent for paper work, purchasing, etc.; accounting and engineering departments may apply similar overhead charges on all labor estimates and work orders, in order to cover payroll accounting, employee insurance, personnel pensions, and related costs.

These hidden carrying charges and fringe benefits have risen to a height where a distinct drift away from maintaining service personnel is noticeable and more work is being contracted from specialty service organizations, such as office painting, window cleaning, street lamp cleaning, painting towers, stacks and structures, and other similar operations. It costs a lot just to carry men on the payroll before they put on their overalls.

It is almost a safe bet that the 15 per cent added to estimates for job contingencies mounts to 100 per cent for overhead before the last voucher is filed away after the final audit. That is why so many service organizations are springing up successfully. By specializing in one particular job and often developing special equipment for it, they can reduce their costs below those of the small plant maintenance forces. It is the hidden overhead that throws the balance to the side of the contract painter most of the time when costs are compared.

Regular inspections are essential to make sure the paint coating is doing its job properly. Deep spots of corrosion are worse than large shallow rusted areas. A good rust preventive job or permanent cure in a few weak spots is worth more than a full paint job over large areas that keep dry and are seldom subject to film breakage or destruction.

As pointed out in previous articles in this series, successive coats of paint should be of different colors so that failures can be identified easily. Simple records, showing painting and inspection dates, should be kept. If make and type of paint is included in this information, useful data will be built up to help future purchasing.

Standard Paints

Once it is established that one type of paint is better than any other for a particular job, a specification should be made for it. This way a great deal of sales talk is eliminated and procurement is boiled down to facts. Inferior products can be rejected more easily if specific requirements are set up.

Once good standard paints have been chosen, stocks should be limited to these brands, which should be displaced only after new paints have been put through routine laboratory and field tests to prove they are better than those in use. It is so easy to get the plant cluttered up with a variety of cans whose backgrounds become hazy to everyone except the individual who picked up the first can and who has never thought if other types of paint will do a better job.

75th Anniversary of Incandescent Lamp

LIGHT'S Diamond Jubilee will be celebrated throughout the country in 1954 by the electrical industry, to mark the 75th anniversary of the invention of the first practical incandescent lamp by Thomas A. Edison, it was announced by George H. Blake, chairman of the planning group of Light's Diamond Jubilee Committee. Plans are being started for nation-wide observances culminating on October 21, 1954, the anniversary date, Mr. Blake said.

All segments of the electrical industry, including electrical manufacturers, wholesale and retail appliance dealers, light and power companies and other groups and organizations are expected to participate.

The theme of Light's Diamond Jubilee, according to Mr. Blake, will be electrical progress, both past and future. "Edison's lamp of 1879," he said, "was the appliance for which Edison developed a complete system for the generation, distribution and metering of electricity to make it practical for general use. That system was the starting point for the electrical development which has contributed so much to our social and economic progress of 75 years."

Edison's intensive experiments in 1878 and 1879 culminated on October 21, 1879, when he found a lamp filament that would endure the intense heat necessary to provide light. At the same time, he was working on a system for the generation and distribution of electricity to make the lamp usable on a mass basis. This system was used for the first time on December 31, 1879, when homes in the village of Menlo Park were lighted by the new lamps.

Standard D-C Motor Connections and Terminal Markings

STANDARD d-c motors may be divided basically into three types: shunt, series, and compound wound. All three types may have the same armature and frame, differing one from another only in the arrangement of the field coils and the wiring around the frame. Each type may or may not have commutating poles and compensating windings, although most machines today are of the non-compensated commutating pole type.

The purpose of applying markings to the terminals of electrical power apparatus according to a standard is

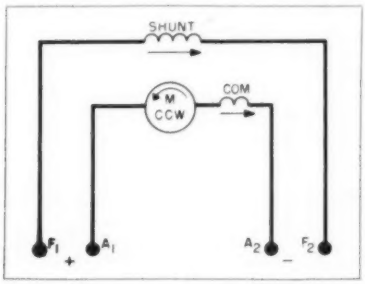


Fig. 1. Shunt motor, counter-clockwise rotation

to aid in making connections to other parts of the electric power system and to avoid improper connections which may result in unsatisfactory operation or damage.

The markings here, which were given by W. W. Selk, of the Motor Engineering Dept., Westinghouse Electric Corp., Buffalo, N. Y., in Vol. XIX of *Maintenance News*, are standard throughout the country and are based on the ASA standard C6.1 "Terminal Markings for Electrical Apparatus".

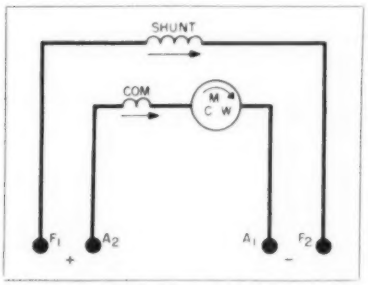


Fig. 2. Shunt motor, clockwise rotation connection

Terminal markings are used to tag only those terminals to which connections must be made from outside circuits or from auxiliary devices which must be disconnected for shipment. The subscript numerals indicate the direction of current flow in the windings. That is, with a standard direction of shaft rotation and polarity, the current in all windings will be flowing from 1 to 2 or from a lower to a higher subscript numeral.

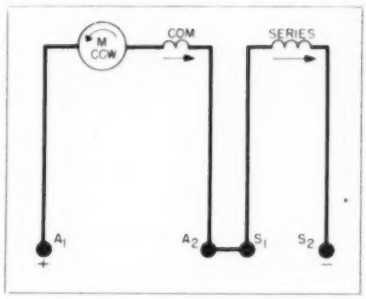


Fig. 3. Series motor, counter-clockwise rotation

In d-c machines A_1 & A_2 always indicates the armature leads, S_1 & S_2 the series field leads, and F_1 & F_2 the shunt field leads.

Motors

The standard direction of shaft rotation for d-c motors is counter-clockwise facing the commutator end or end opposite the drive. To obtain standard direction of shaft rotation, the motor must be connected to the line in such a way that the current will flow through the winding from subscript 1 to subscript 2, then to subscript 1 of the next winding in the proper sequence, subscript 1 of the first winding being connected to one

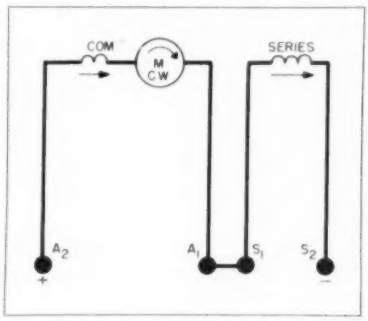


Fig. 4. Series motor, clockwise rotation connection

side of the line and subscript 2 of the last winding being connected on the other side of the line.

Shunt Wound Motors

When leads F_1 & A_1 of Fig. 1 are connected to the plus side of the line, the current flow will be from subscript 1 to subscript 2. The direction of rotation will be standard or counter-clockwise. To obtain a clockwise direction of shaft rotation it is necessary to reverse either the shunt field leads F_1 & F_2 or the armature leads A_1 & A_2, as shown in Fig. 2, but not both.

Series Wound Motors

When lead A_1 is connected to the plus side of the line and lead A_2 connected to lead S_1, the current will flow from a lower subscript to a higher subscript in succeeding windings. Thus a standard counter-clockwise direction of shaft rotation will be obtained as shown in Fig. 3. To obtain a clockwise direction of shaft

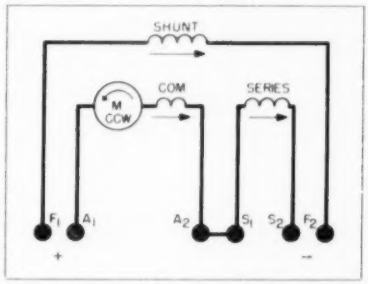


Fig. 5. Compound motor, counter-clockwise rotation

rotation, it is necessary to reverse either the series field leads S_1 & S_2 or the armature leads A_1 & A_2, as shown in Fig. 4, but not both.

Compound Wound Motors

In compound machines, the series field is always tagged such that when current flows from subscript 1 to subscript 2, a cumulative field is produced. Hence when leads F_1 & A_1 are connected to the plus side of the line and lead A_2 connected to S_1, the direction of current flow will be from a lower subscript to a higher subscript in each winding. Thus a standard counter-clockwise direction of rotation will be obtained, as in Fig. 5. To obtain a clockwise direction of shaft rotation, it is necessary to reverse either the armature leads A_1,

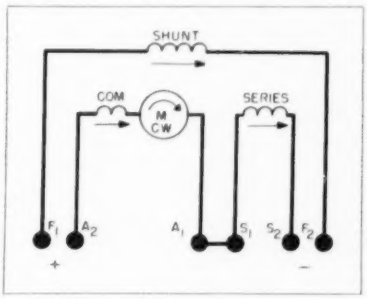


Fig. 6. Compound motor, clockwise rotation

A_2, as shown by Fig. 6, or both the shunt and series field leads marked F_1, F_2 and S_1, S_2. It is necessary to reverse both shunt and series fields in a compound machine. If this is not done, the resulting connection will be opposite the former connection. For example, if the connection had been cumulative compound, it would now become differential compound and vice versa.

Distribution Transformers Start Korean Diesel

They had a 500-kw diesel generator but no compressed air to start it. They did have some single-phase 2300–210/105-v distribution transformers and a supply of electricity, so they figured out how to connect them to produce equivalent of a three-phase autotransformer, which supplied power to motorize generator and start diesel. As author says, "Korea demanded your best" and here's the proof

By ROBERT S. HORN

Electrical Engineer, U. S. Navy Department, Guam

HAVING SPENT time in Alaska some years before going to Korea, and having been an engineer in both places, Korea has frequently reminded me of our northern frontier, insofar as engineering work is concerned. The old saying, "Never say die in Alaska" applies appropriately to Korea, where also you must do the best with what you have, because of the long distance to your nearest supply center.

Solution to a problem that was solved over there in Korea has been considered by several to be a unique way out of a tough spot, so it is related here with the expectation that it may be found useful to others.

No Starting Air Available

The problem was that of starting a diesel engine used to drive a 300-kw alternating-current generator where the compressed air method could no longer be used because of a breakdown of equipment. A limited supply of power at the generation voltage (2300 v) was available at all times from a local distribution line. This, in itself, suggested electric starting, in view of the fact that the generator contained amortisseur windings. A search had been made that indicated that autotransformers of sufficient capacity for reduced-voltage starting were unobtainable in the area.

It was with this information and a knowledge of the limitations of the local distribution line and the capacity of its source that I went to work.

Knowing that the Koreans are always willing to pitch in and help one another free of charge, my first suggestion, which was made without seeing the power plant, was the use of a long rope wound around the flywheel and a tug of war effort to get things going. Because of the location of the engine, this proved to be impractical.

To determine the feasibility of electric starting, an estimate of the required starting current and the starting period was made. The estimate of the starting period was based on an estimate of the starting torque that the generator would develop as a motor and the amount of stored energy in the engine's flywheel at its normal operating speed (327 rpm), which was obtained by calculation from its physical dimensions. The estimate indicated that across-the-line starting could not be used in this particular case. The problem thus became one of obtaining a reduced voltage using some unconventional system that would lend itself to a limited amount of equipment at hand.

Distribution Transformers Tried

Knowing that a few 2300-210/105-v distribution transformers could be obtained, an effort was made to devise a circuit in which they could be connected to provide a near equivalent of a 3-phase step-down autotransformer. The result of this work is illustrated in the accompanying circuit diagrams.

With reference to Diagram (A), Fig. 1, the high-voltage windings of two transformers T_1 and T_2 are connected in series. With the switches SW_1 and SW_2 open, the voltage across terminals 3 and 4 would be equal to one-half the line voltage impressed across terminals 1 and 2, assuming that the transformers were matched. If the switch SW_1 is closed, thereby connecting a relatively light load across terminals 3 and 4, the voltage across these terminals would drop to almost zero due to the series reactance drop caused by the winding P_1 being connected in series with the load. The voltage across the secondary winding S_2 likewise would fall to a value near zero.

It was reasoned that, if the secondary windings could be connected series opposing as shown by closing the switch SW_2, that the secondary winding S_1 having the higher voltage would force current through the secondary winding S_2 having the lower voltage; and that, since this current in winding S_2 would be flowing in the opposite direction to the potential induced in it by a current in winding P_2, winding S_2 would act as a primary, thus magnetizing the core. This in turn would cause an induced voltage in the winding P_2, thereby raising the voltage across the load terminals 3 and 4.

Connecting the secondary windings together in this manner effectively couples the two transformer cores magnetically, which, for the most part, produces the same effect that would result if the windings P_1 and P_2 were placed on a common core as necessary for true autotransformer operation.

This Connection Did It

Diagram (B), Fig. 2, is an open-delta arrangement using two of the single-phase circuits shown in Diagram (A). It was this circuit that was recommended as a suitable substitute for a 3-phase 2:1-ratio step-down autotransformer. By means of these two sets of transformers, 1150 v current was fed to the diesel generator, until the engine started. Once started, the transformers were disconnected, and the generator connected directly to the line. The system proved very effective and, as far as is known, still is being used.

Since returning to the United States the transformer circuit shown in diagram (A) has been investigated thoroughly. The conventional short-

circuit test for measuring the per cent impedance shows that the resulting per cent impedance for this connection is equal to the sum of the rated per cent impedance values of the two transformers used, provided they are similar transformers and providing they have a high-side voltage rating equal to the line voltage.

Circuit (A) Investigated

Where two transformers having the same or different kva capacities are connected as in Diagram (A) and where each transformer has a high-side voltage rating equal to the line voltage, the allowable load capacity, without exceeding the current rating of the smaller of the two transformers, when they are of unequal capacity, is equal to the kva capacity of the smaller transformer.

Above relationship of the allowable load capacity to the capacity of the smaller of two transformers connected as shown in diagram (A) may be visualized as follows. Neglecting magnetizing volt-amperes, core and copper losses, which are relatively small quantities in power transformers compared with their full-load kva ratings, the secondary volt-ampere output of any transformer must equal its primary volt-ampere input. It follows then, that since the secondary winding S_1 of transformer T_1 supplies energy to the winding S_2 of Transformer T_2, whatever energy (neglecting losses) is transferred from winding P_1 to winding S_1 must be transferred from winding S_2 to winding P_2, and from winding P_2 to the load, as there is no other energy path leading away from S_1.

As a consequence, neglecting losses, both transformers must carry the same kva load. The load current is equal to the summation of two currents at junction "J". Where both transformers have identical turn ratios, these two currents are very nearly equal to one another. From this it is apparent that the allowable combined current output of two transformers having identical turn or no-load voltage ratios is equal to twice the full-load high-side current rating of the smaller of the two transformers used in the connection.

Capacity and Voltage Ratios

Where four similar transformers are used in the open-delta connection shown in diagram (B), and where each of the transformers has a high-side voltage rating equal to the line voltage, the 3-phase capacity of the bank is equal to one-half the sum of the four name-plate kva ratings multiplied by 0.866. The factor 0.866 is the same connection factor as that used with conventional open-delta connected transformer banks.

Where four transformers of equal capacity that have a high-side voltage rating equal to one-half the line voltage are used in the open-delta connection shown in diagram (B), the three-phase capacity is equal to the sum of the (four) name-plate kva ratings multiplied by 0.866.

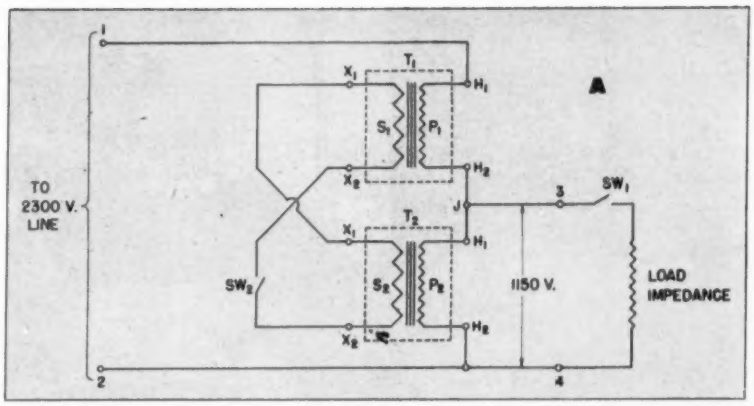


Fig. 1. Diagram (A) showing how two transformers were connected for single-phase voltage-transformation circuit. This circuit was not used at first, but was later investigated and it was proved practicable

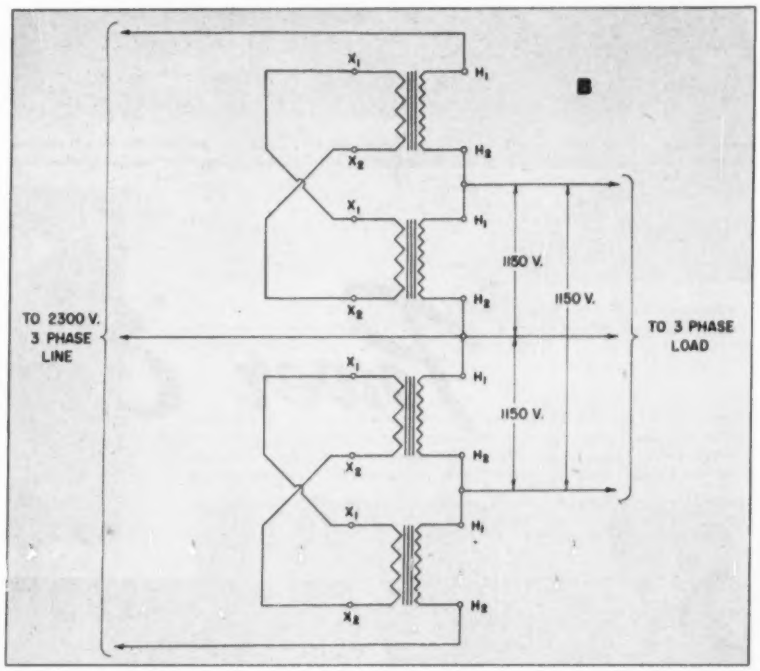


Fig. 2. Diagram (B) shows open-delta 3-phase voltage-transformation circuit using four 50-kva transformers, producing 1150-v power, as actually used to start diesel and still being used for that purpose

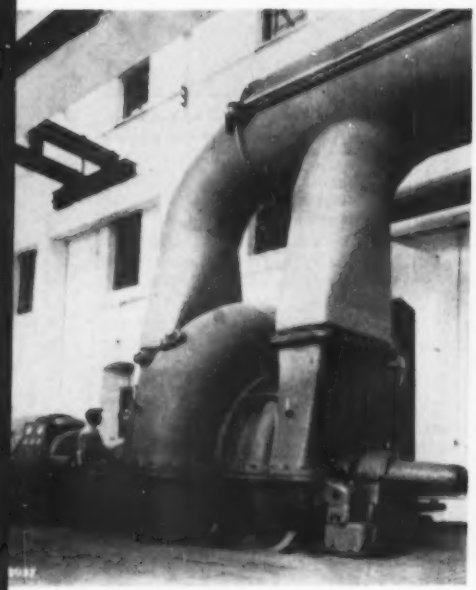
Two similar distribution transformers can of course be connected to obtain a 2-to-1 voltage-stepdown ratio by connecting them in tandem back-to-back. This may be accomplished by connecting the high side of one transformer to the line with the 110-v low side of this transformer connected to the 220-v low side of the second transformer, thus obtaining a voltage across the high side of the second transformer that is equal to one-half the line voltage. The kva output of this tandem connection, without exceeding the current rating of either transformer, is equal to one-half the kva rating of one transformer. If these same transformers were connected as shown in Diagram (A) the allowable kva output would be twice as much; namely, equal to the kva rating of one transformer.

Advantage was taken of the fact that a transformer can carry an overload of several hundred per cent for a period of 2 or 3 min without being overheated. One specific example is a 25-kva transformer having an impedance of 5 per cent. If the primary voltage of such a transformer is held at rated value under load it can deliver a load of 125 kva. Under this load, the secondary voltage will be approximately equal to one-half its rated value, the exact value being dependent upon the power factor of the load. The open-delta bank that was used for starting the diesel engine in question consisted of four 50-kva transformers, which supplied something on the order of 500 kva during the starting period.

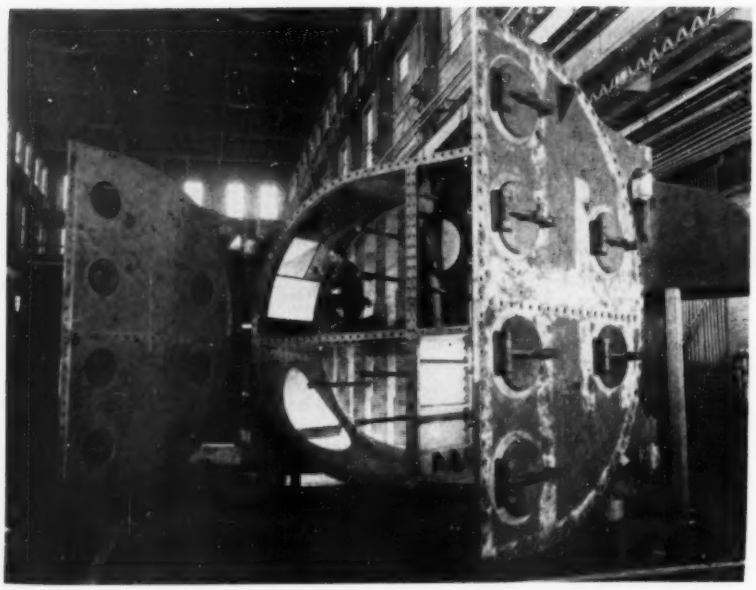
A button hook would have helped when Pacific Telephone and Telegraph installed this 18-ton Cooper-Bessemer diesel in the basement of their Seattle building for standby power. Unit was lowered endwise

Coal comes 70 miles by Illinois River barges to the new Hennepin Station, Illinois Power Company

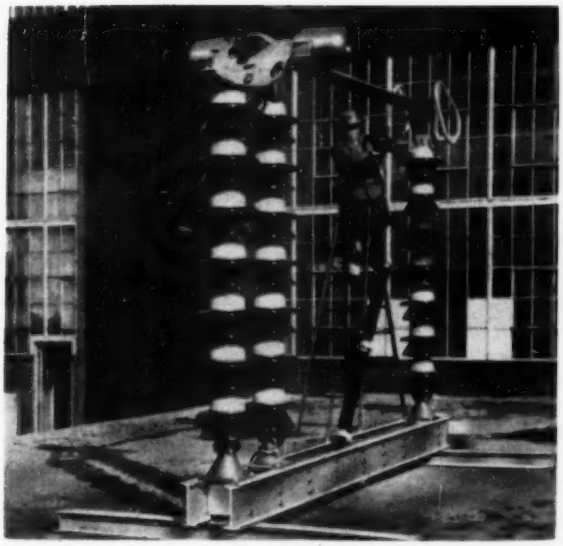
Power Engineering



This evaporator vapor compressor, rated at 250M lb per hr, is now serving Escher-Wyss of Zurich



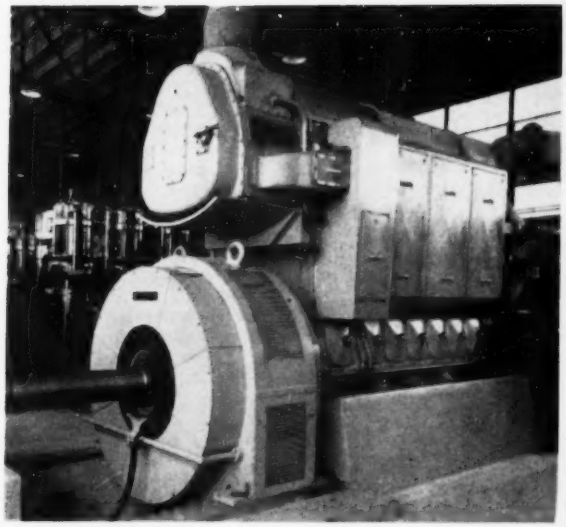
No crane service was available in the condenser area of the plant, so A-C hinged the water box covers of this 50,000 sq ft condenser. The covers are fabricated of 2-in. steel plate and weigh 10,500 lb each



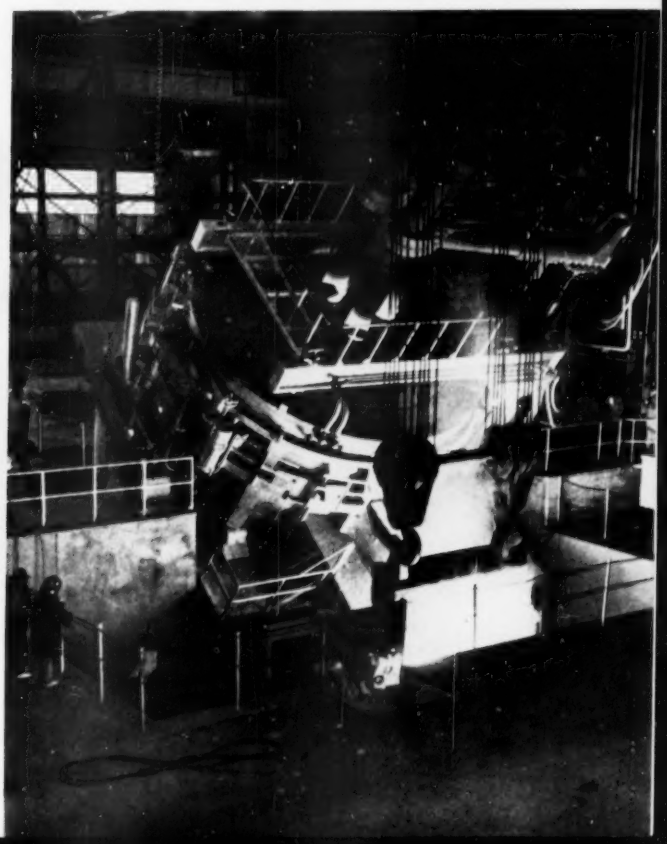
Completion of the first order for 330-kv switches to be placed in the U. S. has been announced by Delta-Star Electric, Chicago. Switches are for AEC

One pole unit of 80-ton, 3-pole, 330-kv circuit breaker is unloaded at its destination in Beverly, Ohio. The breaker will be installed this autumn at the new Muskingum River Plant of The Ohio Power Co. for 330-kv network

Competition between electric furnaces such as this one and open hearth furnaces is developing on a big scale. Recent studies show changeover to be practical. Impact on coal, electric utility, steel and machinery industries would be tremendous. National power output would be increased 12 per cent



Opposed-piston Fairbanks-Morse diesel cut fuel costs from 8 to 3.6 mils per kwh when it was installed in the Teague, Texas, municipal generating plant



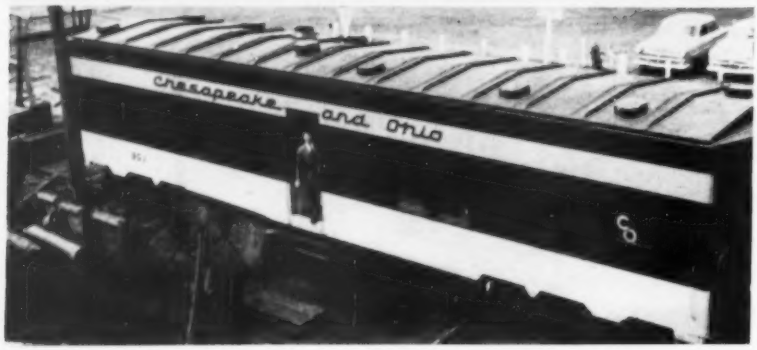


Fig. 1. C & NW's steam generating car (top) resembles locomotive tender from which it was converted
Fig. 2. C & O's version (bottom), adapted from troop sleeper, shown serving tied-up C & O lake ferries

Traveling Steam Plants

Fig. 3. Igniters, combustion controls, C & NW's car

Fig. 4. Steam generator and controls in C & O car

Fig. 5. A motor-driven compressor supplies air for small tools and steam generator's fuel oil atomizer

Fig 6. C & NW's generator car couples to and powers car-mounted pile driver shown on bridge job

TWO NEW MOBILE steam generating plants, built by the Chesapeake & Ohio and Chicago & North Western railroads for their own purposes, have both been subjected to operational tests and have come through handsomely. More than merely "interesting" to power engineers, these plants and others like them can be of considerable help in maintaining plant services when forced outages of steam plants occur.

C & NW's mobile steam plant was developed from an old steam locomotive tender which was available because of the swing to diesel. The car was developed primarily for use by bridge and operating forces when a quick supply of steam is required.

Typical applications include: heating passenger cars being hauled by freight diesels; augmenting the heating plants of passenger diesels when hauling 18-car trains; heating and cooling special convention trains parked on out-of-the-way sidings; supplying steam for wrecker cranes; supplying steam for pile drivers; and heating depots when their own plants are being repaired.

When a flash flood cut off their source of steam, three companies in Sioux City were kept in operation by 3700 lb per hr of steam at 90 and 125 psi delivered by the C & NW car which was pulled into a siding.

C & O's version of the steam generating car was developed in a troop sleeper car. Its most important single job, which it is performing for the first time this year, is supplying steam to C & O's Pere Marquette district ferries when they tie up for the annual Coast Guard inspection. A locomotive was used previously.

During the inspection, required of all passenger-carrying vessels, the boilers are cooled down but the need for steam continues. Steam brought in from the outside source is used for heating, cooking, warming the steam tables, water heating, cleaning machinery before inspection, syphoning septic tanks and boilers (the latter after inspection), and operating the ballast pumps.

After performing this unique service, the C & O car is available for duties similar to those of the C & NW car. Both cars utilize a Vapor-Clarkson flash-type steam generator, C & O's generating 1500 to about 5000 lb per hr at 75 to 300 psi while C & NW's generates 100 to 3500 lb per hr at 75 to 300 psi. Each provides a diesel-electric generator, air compressor, water and oil storage, and automatic boiler controls. The diesel-electric generator for the C & O car is rated at 15 kw and the C & NW unit is rated at 25 kw.

The C & O car also provides a converter which allows substitution of external electric power for diesel-generated power when it is available. Tanks in the C & O car store 4000 gal of water and 500 gal of fuel oil while the C & NW car can store 11,000 gal of water and 2160 gal of fuel oil.

A Step Closer

The Free Piston Gas Turbine

A new Cooper-Bessemer test installation of the free piston gas turbine adds confirmation to its thermodynamic principles. In prospect: rugged, dependable gas turbines with high efficiency

IN JANUARY, 1952, Cooper-Bessemer started operating a free piston gas generator and gas turbine on diesel fuel. At the spring session of the ASME in 1953, Robert Ramsey of Cooper-Bessemer and Commander J. J. McMullen of the Bureau of Ships presented a paper which used data gathered in tests of this unit to paint a bright picture for free piston gas turbine power in general.

Of particular interest to power engineers were the efficiency figures they quoted: 45 per cent thermal efficiency for the gas generator* and 85 per cent turbine efficiency. These values were proved by tests of the 1500 shp (1750 gas hp) experimental unit. Of greater interest to many, perhaps, was the fact that the turbine inlet gas temperature did not exceed 1000 F for rated output.

Compression Ratio vs. Efficiency

The high efficiency vs. low temperature paradox can be answered by pointing out that: (1) Work of compression is performed by the gas *before* it reaches the turbine, and (2) Brayton cycle limiting thermal efficiency LTE is expressed as

$$LTE = 1 - \left(\frac{P_1}{P_2}\right)^{\frac{k-1}{k}}$$

for any heat engine in which P_1 is the initial pressure before compression, P_2 is the combustion pressure and K the ratio of specific heats.

In the free piston gas generator, compression occurs as the fuel ignites and drives the power and compressor pistons outward from the point of ignition. The compressor cylinders are vented to a manifold which in turn vents into the power cylinder when the power cylinder uncovers the scavenge port. When the piston assembly is "bounced" back, the air is compressed again. Compression ratios of 100:1 are possible with this cycle. For comparison, supercharged diesels operate at ratios between 40:1 and 65:1 and continuous combustion gas turbines normally achieve only 6:1 compression. The ideal Brayton cycle efficiency for the free piston gas generator operating at 100:1 compression ratio is 69.7 per cent.

Fuel and Application Studies

Ramsey and McMullen report that experiments with fuels other than diesel are being continued. Presently under consideration are spark-ignited gas, heavy oil, and dual fuels. Increasing the range of suitable fuels would certainly increase the pipe line applications open to free piston gas turbines. In pipe line applications where the fuel for pumping engines comes from the line, the higher efficiency of the free piston gas turbine would allow greater delivery through the same pipe line.

In specific examples cited for cost comparisons, the total station cost for a 10,000-hp centrifugal compressor station (free piston powered) was given as $148 per bhp; for a 15,000 hp station, $138 per bhp. Estimates of capital investment for a 10,000-kw free piston type generating station gave the average cost as $182 per kw. Installed costs of 9,000-hp free piston gas turbine propelling machinery in a C-3 cargo vessel, including labor, were estimated at $158 per hp. Supercharging the gas generator to an inlet pressure of $2\frac{1}{2}$ psi would increase the output of the 9,000-hp plant to 13,000 hp at an increase in cost of $10 per installed horsepower.

*Gas generator thermal efficiency calculated on gas horsepower basis.

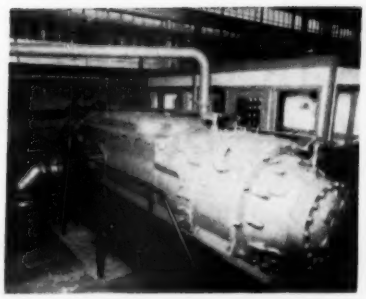


Fig. 1. Experimental 555 cpm F.P. gas generator

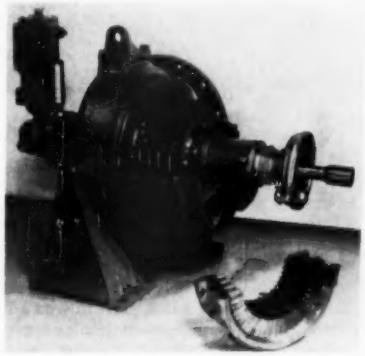


Fig. 2. Dismantled 1500 shp, 14,400 rpm turbine

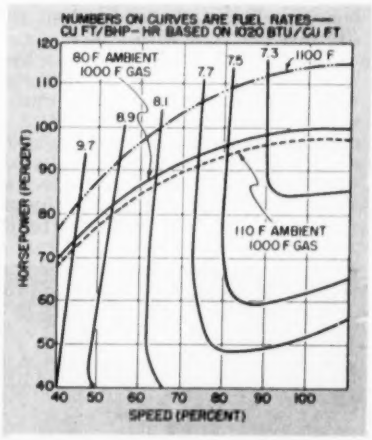


Fig. 3. Typical part load performance from tests

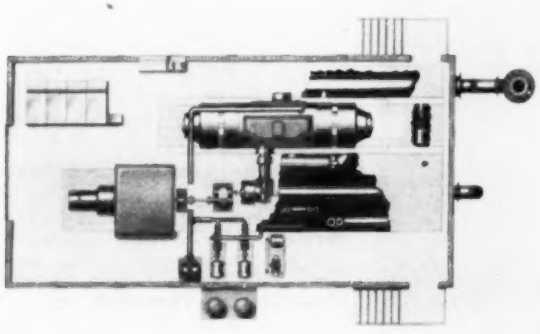


Fig. 4. Drawing of 1000-kw F.P. gas turbine generating plant showing gas generator, turbine, reduction gear, and generator, with piping beneath floor

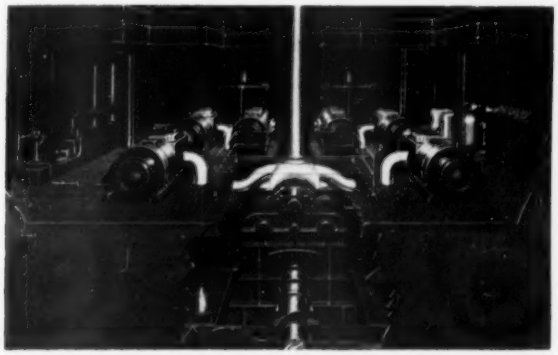


Fig. 5. Drawing of C-3 cargo vessel machinery deck showing multiple F.P. gas generators feeding a 9000-hp gas turbine, which is geared to a screw

Choose Right Oil and Gas Burners

Here are practical tips on oil and gas burners: how they work; fuel-air ratio; features of good control; specific cases of firing oil and gas separately, together, and also with coal

By PAUL R. UNGER

Mid-West Heat Service

TWO IMPORTANT FACTORS in fuel burner design are the method of introducing or atomizing the fuel and the manner in which combustion air is admitted. The finer the atomization, the more surface exposure of fuel particles there will be to mix with combustion air. To hold excess air to a minimum, fine atomization must be accompanied by efficient air registers with directional louvres to throw the air into the fuel stream with enough turbulence to provide rapid reaction between fuel and combustion air (See Fig. 2).

Whether the fuel be oil or gas, the best fuel air union can be obtained when total combustion air is introduced concentric with the fuel. Air register vanes should be adjustable so that flame shapes can be altered to fit varying furnace designs. To secure turbulence, the register throat should be sized for sufficient draft loss across the register to assure a decided spinning action of the air stream as it enters the furnace to mix with the fuel. The smaller the throat ring, the higher will be the air pressure required and the more efficient will be the fuel air mixture. Economics of first cost and power cost to operate forced draft fans balanced against increased efficiency will prevent carrying this to extremes.

Air registers are available for both forced and natural draft operation. If natural draft is used, the registers and throat rings must be large, or the number of burners increased, and the boilers must be operated at relatively high furnace draft at peak loads. Even then, assuming a maximum desirable furnace draft of 0.5 in. there will not be as much turbulence across the registers as there would be using forced draft with 2 in. to 4 in. windbox pressure.

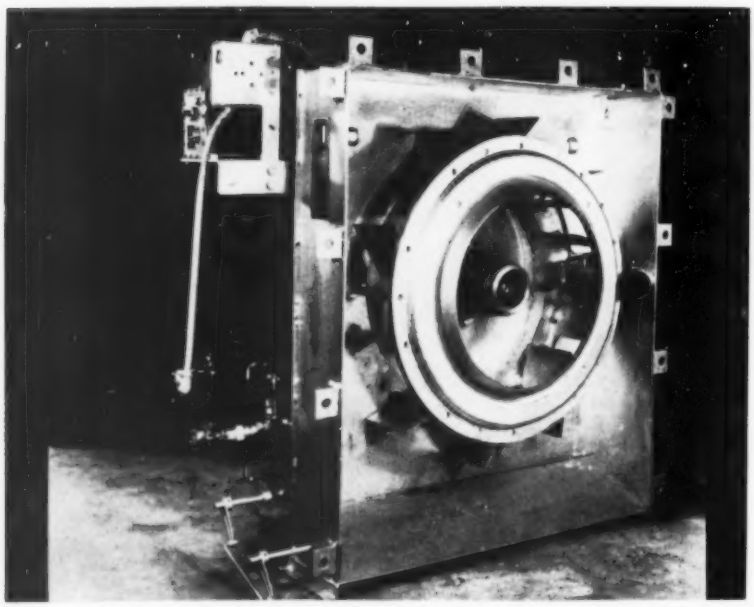


Fig. 1. Combination oil and gas burner with oil burner in place. Same burner shown with gas ring in Fig . 3

At light loads the natural draft requirements would be so low that, without the aid of forced draft, intimate fuel air mixture would be difficult. Besides this, boilers must be watched for air leakage, which at 0.5 in. might become very aggravating. With forced draft, 0.1 in. negative is sufficient and can be held constant.

Forced draft registers are also very adaptable for use with pressurized furnaces which are being used increasingly, eliminating the need for large costly stacks or induced draft fans.

Number of registers and burners used per boiler varies with capacity and furnace dimensions. Generally, boilers with maximum capacities of 30,000 lb of steam per hour require one burner per boiler. Multiple burners are used for larger boilers with individual burner capacities up to 100,000 lb of steam per hour.

With these registers, ring type gas burners and several different types of oil burners can be used. The gas ring, usually cast iron, is set concentric with the oil burner and register vanes, arranged with holes so that the gas stream is swept with air on both sides of the ring. Ring type gas burners should have a minimum of 4 oz gas pressure at low fire. The effective turn down without cutting individual burners out of service will therefore vary with the maximum gas pressure available.

Three types of oil burners generally used with air registers are:

(1) High pressure oil atomization
(2) Oil pressure atomization with steam assist
(3) Rotary cup atomization

1 — High Pressure Atomization

High pressure atomization is made in two types: in one, the inlet oil pressure is varied to change the size of the fire, usually from 300 lb maximum to 75 lb minimum; in the other, 10 per cent above the maximum burner capacity is passed through the atomizer at a fixed pressure of 300 lb, part of the oil is bled off before a final orifice, and the flame size is controlled by throttling the oil return line at each boiler. This type of atomizer is very efficient at high capacities, requires no steam or moving parts, and is suitable for a turn down of 3 to 1 without changing tips or cutting burners in and out of service. Viscosity required for this type is 150 S.S.U.

2 — Steam Atomization Burners

In the last few years there has been a new development in fuel burning; a combination of high pressure atomization with steam assist. This unit consists of a pressure atomizing gun, atomizing oil with a top pressure of 150 deg, and introducing steam beyond the atomizer in a mixing chamber before the fuel enters the furnace. This

burner is installed through the same register as the high pressure burner. Steam is accurately controlled to hold the steam pressure 5 lb below the oil pressure and to limit the steam pressure to 50 lb.

With this arrangement a turn down of 8 to 1 can be achieved with a steam consumption at high fire of 0.4 per cent and at minimum fire of 1 per cent. This burner can be started either with an oil pressure tip or with compressed air. This is the type of burner used in conjunction with pulverized coal in the new Hawthorne Station of Western Electric Co. In this installation, the Todd burners are fired through the center of the pulverized coal burners. Both oil and coal burners are concentric with the gas ring in each Riley register. Unit capacity at this installation is 60,000 lb of steam per hour for each of the four burners on each boiler. Viscosity required for this type is 250 S.S.U.

3 — Rotary Cup Atomization

Most low-pressure heating boilers in size ranges of from 50 to 500 developed horsepower use rotary oil burners. There are three reasons for this:

(a) Rotary cup atomization requires low oil pressure, as it is merely necessary to drop the oil into a flared brass cup revolving at 3600 rpm and let the oil be thrown off tangentially from the end of the cup, there to be picked up by a stream of primary air from the burner fan, usually integral with and mounted on the same shaft that drives the cup.

(b) Rotary cup burners atomize oil at higher viscosities, and therefore lower temperatures than other types, usually 300 S.S.U. or approximately 180 F with Bunker C oil. This temperature can easily be maintained with steam pressures under 15 psi.

(c) Rotary burners are easy to make fully automatic with on-off operation, and with intermediate modulation so that boiler plants can be left largely unattended for long periods.

Rotary burners receive their secondary air in either of two ways: from under the burner through a checkerwork floor, or through an air register similar to that described above, with all combustion air introduced concentric with the oil cup. With the latter method, which is the more efficient, secondary air can be delivered under forced draft with a separate fan, higher capacities can be developed and the burners can be used with pressurized furnaces with either fire tube or water tube boilers.

With this type of installation, the oil burner fan and cup can be swung out of firing position and a gas ring inserted for burning gas. No other change is required to change fuels except to throw a selector switch from oil to gas. All safety and operating controls are usually combined in a single prewired control cabinet.

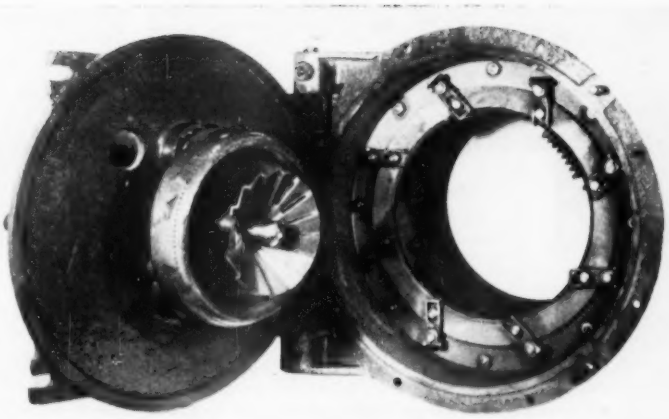


Fig. 2. Showing a register arranged for oil and gas firing with burners swung out of firing position

With the pressure atomizing, or combined pressure and steam atomizing type burners, conversion from oil to gas or vice versa is instantaneous or both fuels can be burned simultaneously. With the rotary cup burner, the oil burner is swung out of firing position and the gas ring inserted to change fuels.

Control System

Where fully automatic burners are used, ignition is usually gas-electric, in which a demand for steam opens a small gas pilot valve, and energizes the spark which lights the pilot. The main oil or gas valve is held closed until the pilot has been proven either by an electrode or flame eye. After the main fire is established, the pilot drops out of the circuit and the flame eye monitors the flame and cuts it off in three seconds if the eye fails to see the fire. Through process of development these control systems have become very effective. They also hold back burner ignition until oil is at the proper temperature, boiler water is at a safe level, atomizing air is at proper pressure, uptake dampers are open, oil or gas control valves are in a low fire position to provide a smooth start, and the burner is latched in firing position.

After ignition is complete, the flame size is modulated in proper coordination with a supply and uptake damper to hold steam pressure as closely as possible and minimize the number of starts and stops.

Where burners are manually ignited and operated through combustion control systems, safety controls should be used to monitor the main gas or oil flames, and to cut off the fire in case of flame failure or low water, and to provide a signal alarm

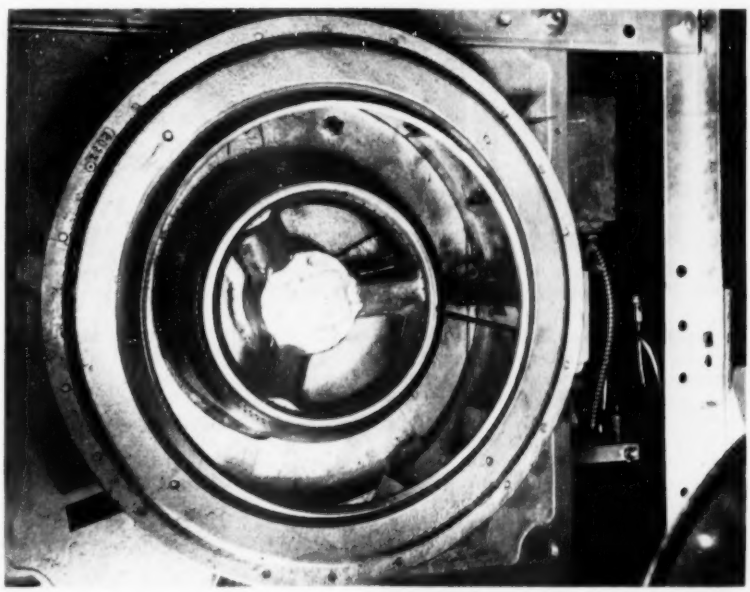


Fig. 3. Combination oil and gas burner with gas ring in place. Same burner with oil burner is in Fig. 1

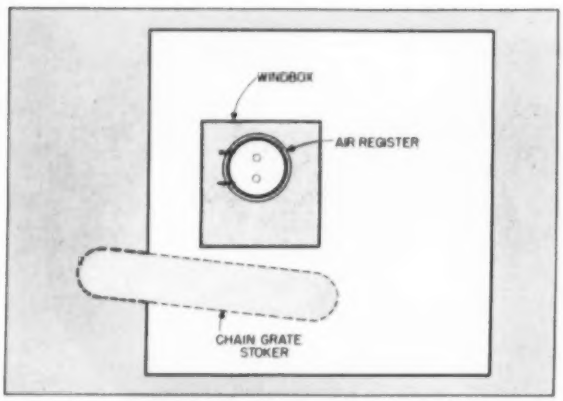


Fig. 4. Diagram showing forced draft gas burning installation for 16–30,000 lb per hr boilers using side firing over natural draft chain grate stokers

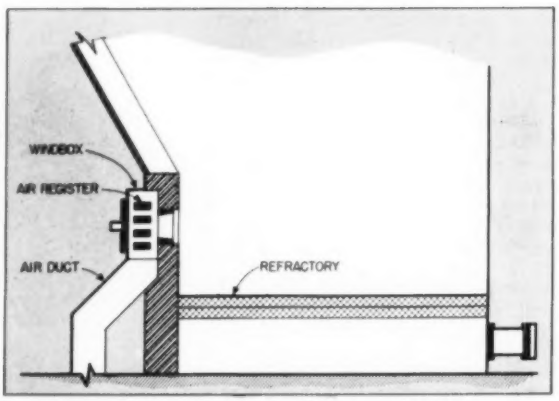


Fig. 5. Forced draft combination gas and variable capacity high pressure oil atomizer, rear fired, over the forced draft type stoker on 3–60,000 lb boilers

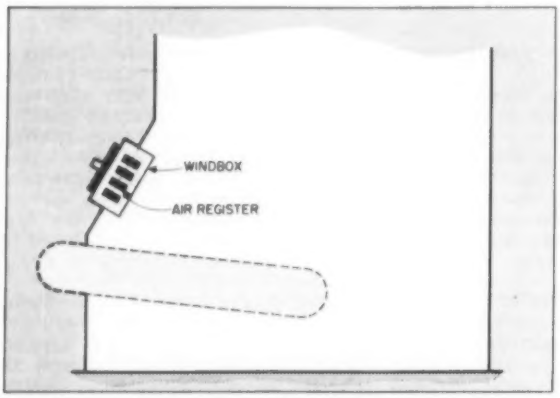


Fig. 6. Forced draft combination oil and gas firing down at angle over stoker

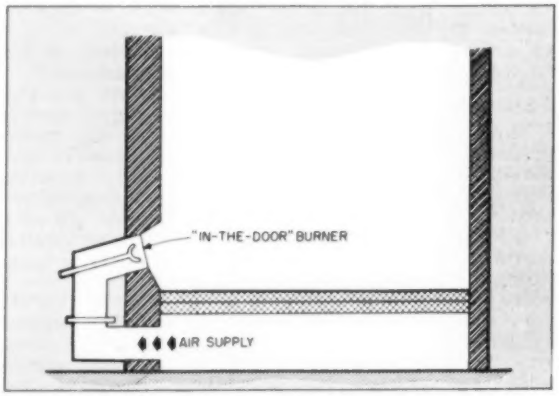


Fig. 7. Forced draft register with gas rings and oil guns set in fire doors

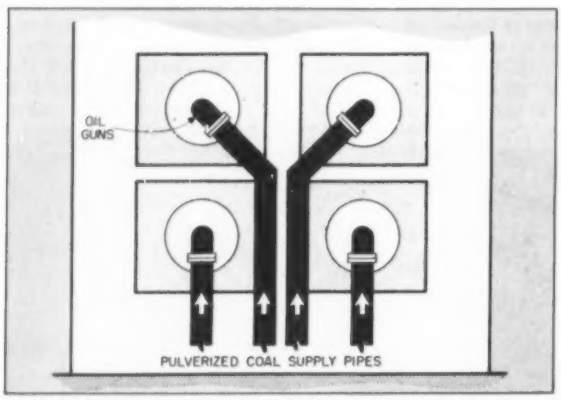


Fig. 8. Pressure atomizing steam assist burners through pulverized coal registers. Four registers per boiler, capacity 200,000 lb/hr per boiler

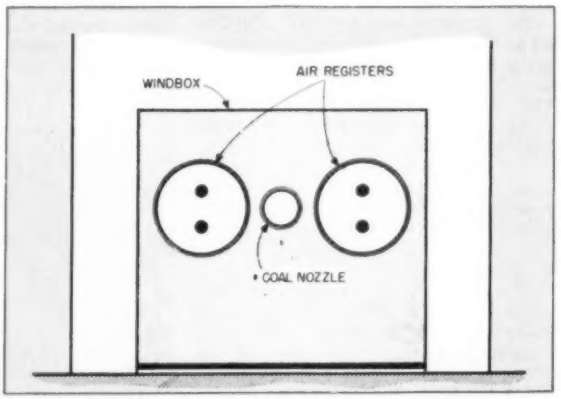


Fig. 9. Diagram of forced draft gas burning installation with spreader stoker nozzle between gas burning registers at Michael Reese Hospital, Chicago

on such failures. Where multiple burners are used on one boiler, each burner should have separate flame eyes and shut off valves. Burners should be lighted only with a pilot or torch and never off the hot brickwork, or from an adjacent burner. Many a smart fireman has regretted not following these instructions.

There are several methods of applying oil or gas burning equipment to fire in conjunction with coal burning boilers. We have made installations in the following manners, which I think cover most methods:

(1) At Armour & Co., Union Stock Yards Plant, (see Fig. 4) we installed two forced draft registers with gas burners over natural draft chain grate stokers, on one side of each of sixteen 1000-hp boilers. The side walls were solid, and we laid firebrick over the grates when burning gas. This is an off peak gas contract, burning coal six months and gas six months.

(2) At the Armour & Co. Soap Works, we made a similar installation, but with one burner on each side of each boiler firing opposite, and used 5 in. of ash on the grates instead of firebrick. This plant has an interruptable gas contract and must swing from gas to coal on seven boilers in one hour. In switching from gas to coal they start the stokers, dropping the ash bed and letting the gas burners light the coal.

(3) At Darling & Co., (see Fig. 5), we have three forced draft registers with gas and oil burners firing

(*Continued on page 102*)

Power Engineering's

PRACTICAL ENGINEER and ELECTRICIAN SECTION

CONTENTS

- Selection and Maintenance of Centrifugal Pump Seals 82

questions and answers 84

- How Prevent or Correct Softening of Welded Aluminum Pipe?
- What Is Wrong With This Engine?
- What Causes Water Hammer In This Tail-Pipe?
- How To Figure Pneumatic Conveyors?
- What Caused Water Level Irregularities?

practical hints and kinks 87

- Mimeograph Stencil for Etching Metals
- Step Down a Step-Down Transformer
- Short-Stopping Selenium Rectifier Troubles
- Lights When the Lights Go Out
- Gage Glass Erosion Attributed to Alkalinity
- The Elusive Fly Ash
- Identifying Alarm Circuits

- Curves for Figuring Steam Losses Due to Jets or Leakage 94

Selection and Maintenance of Centrifugal Pump Seals

Here are some tips on selecting the proper pump seal for the job and giving them proper maintenance when installed. It is a refresher for old-timers but "must" reading for young-timers

By J. A. CABLE
Application Engineer
Norwood Pump Section, Allis-Chalmers Mfg. Co.

PROPER CARE OF stuffing boxes is particularly necessary in power plant pumping since so many applications demand that the stuffing boxes completely eliminate any possibility of in-leakage of air. This is because in most cases the stuffing boxes have to seal properly on pumps with negative pressures existing at the inboard ends of the boxes.

Packed Stuffing Boxes

To connect the impeller with the driver, the pump shaft has to pass through the casing. The point of entry of the shaft into the casing is called the stuffing box and the purpose of its arrangement is to "throttle" the leakage which tries to get out of this opening.

Basic elements of the typical stuffing box are shown in Fig. 1. They are shown assembled in Figs. 2 and 3, and the major elements are as follows:

1. *Packing*, which is graphited asbestos for most clear liquids at medium pressures and up to 250 F and metallic for high pressures and high temperatures (1, Fig. 1).

2. *Shaft Sleeves* are usually bronze in general service water pumps; otherwise, they are of the same material selected for the wetted pump parts. For high pressures or temperatures when metallic packing is necessary, a hardened chrome steel such as A.I.S.I. 420 is often used (2, Fig. 1).

3. *Seal Cages* (also called lantern rings or waterseal rings) serve as a means of distributing the sealing liquid uniformly around the annular space between the core of the box and the sleeve surface. This part may be eliminated in favor of another ring or two of packing if the stuffing is packed to seal against high pressures (3, Fig. 1).

4. *Glands* are to position and adjust the packing. They are usually split to facilitate removal for repacking (4, Fig. 1).

Pumps with packed stuffing boxes *must* leak slightly to operate properly. The slow drip coming out should be looked upon as nothing more than a visible sign that the packing is being lubricated.

The most prevalent stuffing box arrangement is shown in Fig. 3. Here the liquid pumped must be suitable for use as a packing lubricant. This arrangement is called an internal seal.

Difficult Liquids vs. Boxes

When the liquid pumped does not have acceptable lubricating properties, such as in the case of dirty river water which would be abrasive, external seal arrangements as shown in Fig. 2 are recommended. Here the seal cage is supplied with clean water or some liquid which is compatible with the product being pumped. This clean liquid is brought in under pressure and provides lubrication for the packing and also assists in keeping any undesirable abrasives that may be suspended in the product out of the stuffing box. The line bringing this sealing liquid to the pump should be valved so that its pressure can be throttled to just the right amount to have a slow drip escape from the box, the same as with internal seals. Incidentally, since the seal cage is approximately centered in the box

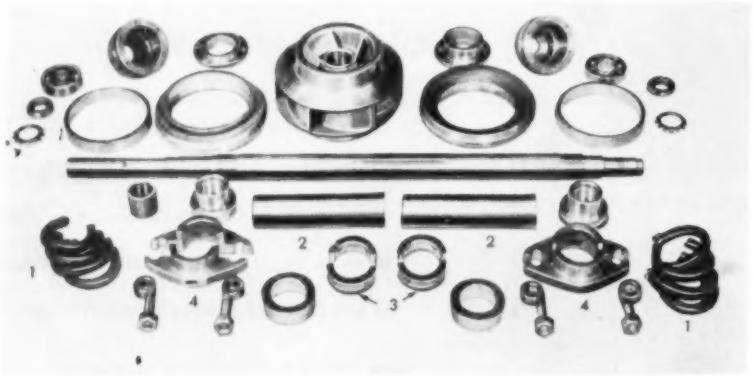


Fig. 1. Major parts of the stuffing box are (1) packings, (2) shaft sleeves, (3) seal cages, and (4) gland

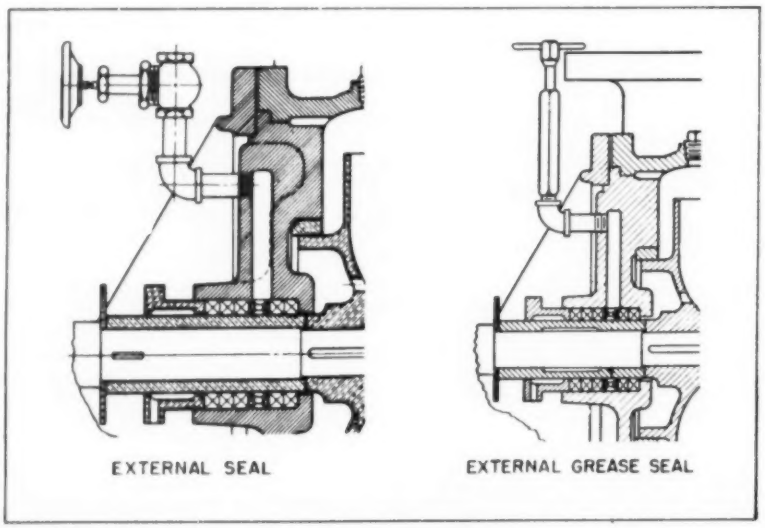


Fig. 2. A separate source of seal lubricant is required when the liquid being pumped is abrasive or otherwise unsuitable. The second liquid (or grease) lubricates and keeps undesirable liquid from box

length, you can expect that if properly packed the amount of seal fluid getting into the pump will be about the same as that dripping out of the gland. Be sure to allow just enough flow in this arrangement so that the gland doesn't have to be pulled up abnormally tight to hold back the leakage.

Repacking Hints

When stuffing boxes are repacked, the following pointers will help improve the job:

1. Seal cages, when used, should be checked as to location before removal so that they will be returned to their proper positions. This is easily done by counting rings between the seal and gland, then the gland and bottom of box.
2. Never replace only the outer ring or two. The bottom ring in the box does the most work and if it is not renewed, any improvement obtained will be short lived.
3. Check sleeve surface; a badly scored sleeve will rapidly ruin a new set of packing.
4. Stagger joints in adjacent rings so that the liquid cannot find an easy way out.
5. When restarting, it is well to have the gland quite loose, just tight enough to prevent in-leakage of air and to be sure that no leakage comes out around the outside of the packing. All leakage must flow along the shaft to lubricate the packing and prevent overheating.
6. Don't switch from asbestos to metallic packing unless the sleeve material is also changed to a hardened material. Your pump instruction book will suggest several satisfactory brands of packing for your condition.
7. Most pumps can also be fitted with mechanical seals to perform the packing job mechanically and can be so equipped without major modifications. Application of the various types of mechanical seals will be discussed in the following paragraphs.

Mechanical Seals

Fundamentally, a mechanical seal consists of two primary parts, one sealing face being stationary, and the other affixed to and rotating with the shaft. The close-lapped clearances between these two faces prevent leakage of liquid out or air in.

Choice of seal types, as with packed boxes, depends on service and type of liquid pumped, especially in terms of its lubricating properties. The most common arrangement is the single inside type (Fig. 4).

Here the stationary member is mounted in a solid plate which takes the place of the gland or in some cases in a special stuffing box made with its outer end integrally enclosed. The rotating member rotates in the liquid handled. It is the usual practice to use the internal seal passages to circulate the product pumped in the stuffing box cavity and thus assist in cooling the sleeve by carrying away some of the heat that is generated.

Standard seals of this type are suitable for differential pressures to around 200 psi and special balanced seals are available and in use at pressures to 1500 psi.

Difficult Liquids vs. Seals

When the product handled by the pump does not qualify as a suitable lubricant, we have two types of seals to consider. First, a single outside seal as shown in Fig. 5. Here the rotating member runs outside the stuffing box and only the stationary face piece is immersed in the pumped fluid. These are often arranged with an external seal connection to lubricate the sealing faces from an outside source and also can have an integral cooling passage in the end plate in case high temperatures are involved.

With this outside mechanical seal arrangement, differential pressure limitations are in the range of 20-30 psi. This arrangement is used when any leakage must be immediately apparent. Figure 5 shows an outside mechanical seal and from this illustration you can see that when leakage does occur it will be readily seen. This is in contrast with the inside type shown in Fig. 4 where the leakage would have to creep along the shaft and out through the end plate before it became apparent.

Another choice for difficult liquids is the double mechanical seal. Here two mechanical seals are used in a back to back arrangement where some common parts serve both seals. Fig. 6 shows a typical double seal.

Though double seals are used in the most extreme problems, they should require the least maintenance, since the product handled does not get to the seals and they are lubricated by a medium selected just for that purpose.

Replacing Mechanical Seals

Mechanical seals differ from packing, which must leak slightly, in that operating correctly they do not leak at all. Generally speaking, on clear liquids without solids in suspension they can be expected to give excellent service. Until such time as leakage appears, it is best not to dismantle for inspection. Most seal manufacturers recommend that once seal faces are disturbed, they should be renewed. It is common practice to keep a spare set of parts on hand so that these faces can be replaced when they become worn. It is possible to have the seal faces relapped by the manufacturer, but whether or not this is economical will depend on the size of the seal and the frequency of repairs.

Any special instructions for the installation and use of specific seals are made available to the pump manufacturers and are supplied to the ultimate users along with associated instruction material for the entire pump. Always check the manufacturer's catalog for procedures.

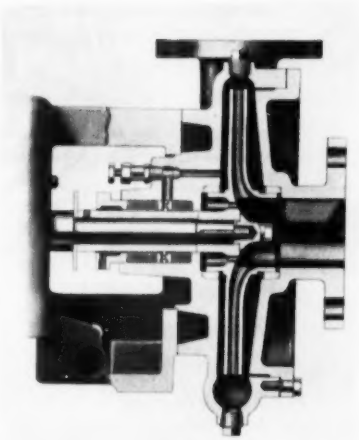


Fig. 3. Internal seal in a single-suction pump. The liquid being pumped serves as seal lubricant

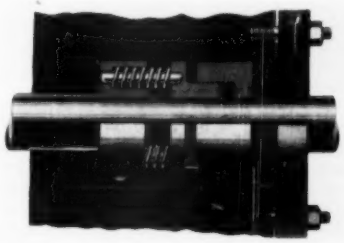


Fig. 4. Single internal mechanical seal shown is the most common of this type; inserts in the box

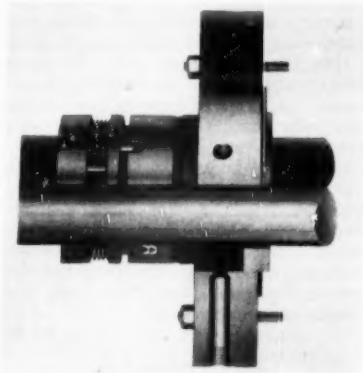


Fig. 5. Single outside mechanical seals are used where any leakage must be disclosed immediately

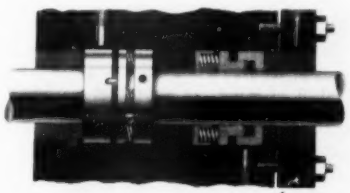


Fig. 6. Stuffing box fitted with double internal mechanical seal, used on chemicals and abrasives

Questions and Answers

Your fellow engineers will answer your power plant questions. You answer theirs, get paid well. Simple? Effective? Why don't you try it?

Question No. 516

How Prevent or Correct Softening of Welded Aluminum Pipe?

SINCE THE END of World War II we have been gradually changing over from rill irrigation to sprinkler systems. At present we have in service more than two miles of aluminum irrigation pipe, 2 and 3 in. in diameter, in 20- and 30-ft lengths. The lines are taken apart and reset twice daily and, being set among fruit trees, there is frequent bending of the light aluminum pipe. Any attempt to straighten the pipe generally results in rupture of the thin-gage metal at the inside of the bend.

We successfully weld the broken pipe or any holes in it with an oxy-acetylene blowpipe, but the welding leaves the pipe so soft that quick lifting of the empty pipe often bends it.

We know nothing of the constituents of the alloy, or alloys, of which the pipe is made. Its trade name is "Steelume", and we know that heat makes it remarkably softer. We are not sure whether the pipe loses its work hardness when heated (it appears to be extruded), or whether a hardening element like bismuth in a babbitt is burned out of it. We have been going on the assumption, however, that its hardness is due to the extrusion or rolling procedure and not to alloying elements.

To state our problem simply, what can we do to harden this aluminum pipe after welding (*or prevent softening, Ed.*)? Although this pipe costs us as much as 75 cents per ft, we are not prepared to go to any great expense for equipment to redeem the damaged pipe sections.

O. L. B.

Answer to No. 510

What Is Wrong With This Engine?

Demere's Comprehensive Reply

WE PRESUME the engine in question is of the Corliss type.

The indicator reducing motion should be adjusted so the card drum will not bump at the end of stroke.

Both H and C cards clearly indicate very late admission which can create a pound in the engine. Admission line should continue vertically from compression line, then drop off at cut-off to form the expansion curve.

Check eccentric marks to see if eccentric has slipped and become late. If the engine is of the double eccentric type, it will be an easy matter to make the proper adjustments on both steam and exhaust valves separately.

If cards are actual size, the back pressure is 40 psi instead of 33 psi.

The engine appears to be lightly loaded and may operate better if the boiler pressure is lowered at least enough to admit steam for one quarter of the stroke.

Memphis, Tenn. C. DEMERE

Wayne's Diagnosis

O. H. D. STATES that the boiler steam pressure and engine throttle pressure are 155 psi. Since a pressure drop in the steam is necessary to permit flow, I question if the throttle pressure is really 155 psi.

Analysis of the cards leads me to believe that early cut-off of the steam admission is the cause of these unusual diagrams. If the steam admission port is closed too soon after the piston starts its travel, an insufficient quantity of steam will be admitted to the cylinder. As a result, the steam expands while the piston is moving through approximately 70 per cent of its stroke. The combined momentum of the flywheel and piston will carry the piston past this point, however, and the cylinder pressure will continue to decrease as the cylinder volume increases. This is shown by the line dropping below the exhaust or back pressure line on the cards. When the piston has traveled far enough to uncover the exhaust ports, the back pressure almost immediately raises the cylinder pressure to the value of the back pressure. This is shown on the cards by a sharp rise in pressure at the exhaust ends of the cards.

O. H. D. can correct this fault by adjusting the valve motion. If the engine has a "D" slide valve, the valve crank should be moved a few degrees at a time, counter to the rotation of the flywheel, until satisfactory cards are obtained.

Examination of the cards indicates that the valve mechanism ("D" slide or other) is not "centered"; i.e., the closing of the admission port does not occur at the same distance of piston travel from both ends of the cylinder. This can be adjusted in a slide valve engine by resetting the position of the slide valve on its rod.

If this adjustment does not correct the problem, I suggest O. H. D. check the steam pressure at the engine to determine if its value is lower than that required, or if the back pressure is higher than that for which the engine is designed. It is possible that a combination of both of these differences is present.

The accompanying sketch shows the diagram submitted by O. H. D. superimposed upon an ideal card for the head end.

Brooklyn, N. Y. H B. WAYNE

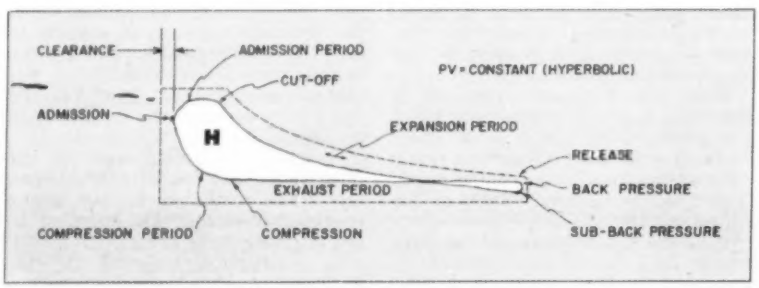
Check Indicator, Says Moulton

THE DIAGRAMS are unusually long (5 in.); the compression is early accompanied by late admission and early cut-off; cut-off is so early that expansion is carried below exhaust pressure.

The early cut-off is caused by valve misplacement and not by governor action. The head end in admission is not quite so late as crank end which has a pronounced loop (or bird bill) caused by slow opening of admission valve; compression is carried to end of stroke and when the piston starts forward, pressure drops until steam valve opens, then pressure slowly rises. Here we see that the piston moves forward 2 in. before admission reaches full pressure, and there is a drop of 24 lb from throttle pressure as given.

Head end is a little better but not much. Indicator motion is too long allowing drum to come up against stops as shown by sharp corners on release line. A diagram like these can only be produced by a double eccentric valve gear, so the obvious remedy is to advance the steam eccentric and even up admission at both ends. Expansion could be a little later depending on how engine runs after adjusting steam valves. O.H.D. did not say if engine was knocking.

By measuring cards we get the following data not given in question: length of both cards, 5 in.



Wayne's "ideal card" for the head end compared with O. H. D.'s card. No attempt is made to scale card

Head end: Height of diagram, 1.62 in. Cut-off, ¼ of stroke. Initial pressure, 1.62 × 80 or 129.60 psi. MEP by ordinate is 23.96 psi. Back pressure average is 35 psi. As 5 in. on card represents 48 in. of stroke, 1 in. on card equals 9.6 in. of stroke. Compression begins at 0.57 in. on card, or 5.47 in. before end of stroke, and is carried to 113 psi. Loops on diagrams cancel themselves out.

Crank end: Height of diagram 1.64, in. Initial pressure, 1.64 × 80 or 131.2 psi. MEP by ordinates, 24 psi. Cut-off, about ⅛ of stroke. Back pressure, 40 psi average. Expansion is carried to 26 psi. Compression begins at 0.55 in. on card, or 0.55 × 9.6 = 5.28 in. from end of stroke, and is carried to 113 psi (same as head end).

Horsepower calculated from cards: Piston diameter, 26 in., giving an area of 530.93 sq in. Diameter of piston and tail rods is 5 in. giving an area of 19.63 sq in. Net area of piston, is 530.93 less 19.63 sq in. MEP of H end, 23.96 psi. MEP of C end, 24 psi. Average of both cards is 23.98 psi.

$$HP = \frac{23.98 \times 4 \times 511.29\ \ 2 \times 93}{33000}$$, or

279 hp. With a MEP of 40 psi, which is a fair average, this engine would indicate

$$HP = \frac{40 \times 4 \times 511.29 \times 2 \times 93}{33000}$$, or

465 HP.

Note: Throttle pressure given here is same as boiler pressure, which means no drop in steam pipe.

ALBERT H. MOULTON
Pittsfield, Mass.

Schaefer's Analysis

A LITERAL TRANSLATION of the card, referring to the head end, can be evolved by tracing along the card line. As the piston begins its forward movement, denoted by the exhaust line on the card some compression begins to take place causing the steeply sloping line on the head end. Since the valve is late in opening, the piston begins its return stroke just before the steam is admitted to the cylinder.

The increased volume caused by the moving piston is accompanied by a pressure drop due to the small volume of steam being admitted at that precise moment, and this causes the small loop to form. The larger loop on the right-hand side of the card is caused by the steam in the cylinder being insufficient to do work on the piston for the full length of the stroke, the result being that the pressure in the cylinder during the last 27-28 per cent of the stroke is below the exhaust pressure. The loop returns to the exhaust level by permitting steam to enter from the exhaust line into the cylinder (reverse flow) when the exhaust port is uncovered.

The situation is similar on the crank end, with a somewhat more exaggerated problem of late opening on the intake port.

As the engine is currently operating, a cursory calculation indicates that the hp developed is about 50 per cent or less than that which the engine is capable of delivering. The hp figures, of course, would be contingent upon a further analysis of the engine, with respect to the clearance volumes involved and the pressure drops through the throttling valves and steam ports.

The indicator diagram discloses that the steam valve has a late opening; this, of course, could easily be rectified by advancing the valve to permit the steam to begin entering the cylinder when the piston is at the dead center of either the head or crank end. The eccentric should be set to give equal velocities at opening and closing on both ends of the stroke.

Harrison, N. J. R. A. SCHAEFER

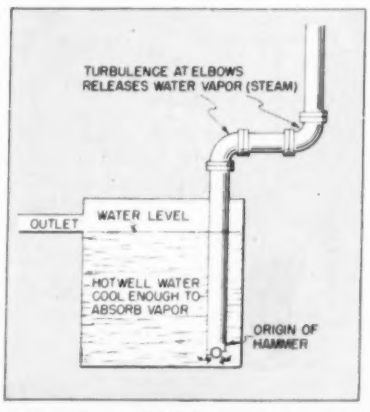
Answer to No. 511

What Causes Water Hammer In This Tail-Pipe?

Absorbed Vapor at Tail-Pipe Outlet—Brage

AS I SEE this problem, after a review of my experiences with similar problems, the hammer occurs when water vapor (or steam) is absorbed by the water of the hotwell in the immediate vicinity of the tail-pipe outlet. In this system the noise created by the absorption of steam in the hotwell should be no different than that which takes place when steam from any source is injected into water at a temperature appreciably lower than that of the steam. There will be wave motion of the liquid transferred to the air as sound by any part of the container or appendages free to vibrate.

The turbulence set up by the interrupted free fall at the elbows doubtless contributes to the amount of vapor reaching the end of the tail-pipe. It is quite possible, however, that a fundamental cause such as insufficient water, water at a too-high temperature, or incomplete mixing with steam from the jets may be the real cause.



End pipe above water to stop hammer at the outlet

Disregarding any initial velocity of the water, the acceleration of gravity in a drop of 60 ft will give the water velocity enough to create a fairly high vacuum along the walls of the pipe. This vacuum will be filled in part with vapor drawn from the water. If the tail-pipe is too large for the amount of water flowing, for example, water vapor may be aspirated into the tail-pipe through the vent.

As a test on the above, I suggest that E. E. M. end the tail-pipe, or at least vent it, into the vapor space above the level of the water in the hotwell. If he does not make use of the heat as a by-product, he can then vent any excess water vapor to the atmosphere.

OLIN LEE BRAGE
Oroville, Washington

Bleed in Air, Says Brown

E. E. M.'S QUESTION regarding water hammer does not include some very pertinent information such as the rate of condensing water flow, tail-pipe temperature and condenser pressure at which his steam jet refrigeration unit will work satisfactorily.

However, from the limited information contained in the sketch and the description of the trouble, we would suspect the reported tail-pipe water hammer is probably due to "tail-pipe flashing." This "flashing" occurs on some installations and is due to minor fluctuations of condenser pressure which are sufficient to flash off (vaporize) some of the heated tail-pipe water.

The vapors thus formed collect into a bubble which acts to prevent normal flow of water through the tail-pipe and/or condenser until such time as a sufficient head of water is built up to collapse and condense the vapor bubble. This collapse and the subsequent inrush of water causes a severe water hammer which may shake the entire installation and may cause equipment damage similar to centrifugal pump cavitation damage.

In general this "tail-pipe flashing" causes quite noticeable variations in the flow of water from the hotwell and often is mistakenly attributed to variations in condensing water flow.

The tail-pipe installation, which is of a type generally conceded to be unsatisfactory, undoubtedly aggravates the situation although, in itself, it may not be responsible for the trouble.

We suggest E. E. M. first close off his 6-in. vent line, which runs from the far end of the horizontal run of tail-pipe back to the con-

denser, and then arrange to bleed a small amount of air *into* the condenser. The amount of air required will necessarily be determined by trial and error and will probably vary over different seasons of the year. Bleeding air into the condenser will drop the condenser vacuum slightly, but should minimize the flashing tendency and the water hammer.

If this proves effective, E. E. M. can arrange a variable bleed and determine how much drop in vacuum (usually 0.1 in. Hg or so) is required. It may be necessary to revise the tail-pipe to insure completely trouble-free operation. All barometric condenser tail-pipes should be either vertical or pitched sharply downward, particularly above the water level.

Phillipsburg, N. J. C. T. BROWN

Apply Impulse-Momentum Theory — Wayne

TO AVOID water hammer, the velocity of the hot water (condensed steam and cooling water) through a pipe should be limited to 5-8 ft per second and not greater than 10 ft per second. E.E.M. does not give the water and steam flow quantities and therefore the velocities through the piping system can not be calculated. The fact that hammer does not occur at the lower vacuum (27.8 in. Hg) when the flow quantity is lower than at the higher vacuum (29.75 in. Hg) when the flow quantity is higher, indicates that high fluid velocity is the cause of this trouble.

The well-known impulse-momentum theory may be applied to this problem to determine if water hammer results from high fluid velocity. The expression for this relation is given by the following formula:

$$Fdt = \frac{W}{g}\,dv, \text{ or } F = \frac{W}{g}\,\frac{dv}{dt}$$

where F = force (lb), W = fluid weight (lb), g = acceleration due to gravity (32 ft per sec per sec), V = velocity (ft per sec), T = time (sec), and $\frac{dv}{dt}$ = acceleration.

The following expression may be used to calculate the vertical reactive force in an elbow:

$$F = A \times \frac{W}{g} \times V^2 \sin a$$

where F = force (lb), W = fluid density (lb per cu ft),
g = acceleration due to gravity (32.2 ft per sec per sec),
V = fluid velocity (ft per sec), and
a = angle between the horizontal plane and the elbow inlet or outlet. For an angle of 90°, sin a = 1. For a 90° elbow, therefore,

$$F = A \times \frac{W}{g} \times V^2$$

An emperical formula for computing water hammer due to excess pressure head is as follows:

$$H = \frac{aV}{g};$$

where H = maximum excess pressure head above normal (ft), V = fluid velocity (fps), g = acceleration due to gravity (ft per sec per sec), and

$$a = \frac{4660}{\left(1 + \frac{KD}{ET}\right)^{1/2}}$$

where, in turn, K = bulk modulus of water (294,000 psi), D = inside pipe diameter (in.), E = pipe wall modulus of elasticity (29,400,000 psi), and T = pipe wall thickness (in.).

After computing the fluid velocity when developing a vacuum of 29.75 in. Hg, E.E.M. may substitute the proper numerical values in the above formulae to calculate the forces in the elbows due to the momentum changes and the excess pressure head above normal due to water hammer.

In conclusion, the following procedure is recommended:

1. Calculate the fluid velocity (condensed steam and cooling water) when a vacuum of 29.75 in. Hg is obtained.
2. If this velocity exceeds 10 fps, increase the size of pipe and fittings to keep the velocity at 5 to 8 fps.
3. Use gradual pipe size reductions and avoid sudden changes in the direction of the flowing fluid; i.e., use laterals instead of tees and two 45° ells with a nipple instead of a 90° ell.

Brooklyn, N. Y. H. B. WAYNE

Answer to No. 512

How to Figure Pneumatic Conveyors?

Holmes Gives References

I WISH TO ADVISE the writer of Question No. 512 that I have in my library two books which I find have been extremely helpful in the designing of pneumatic conveyor systems for corrugated and solid fibre boxes, cartons and shipping container scrap. The above books are chock full of information and will give him the answers that he is seeking with respect to the handling of sawdust.

These books are "Fan Engineering" published by Buffalo Forge Co., Buffalo, N. Y., copyrighted in 1948, 5th Edition, $6.00; and "Practical Design of Exhaust and Blower Systems" by E. W. Favadora, published by Edwin A. Scott Publishing Co., 45 W. 45th St., New York 19, N. Y., copyrighted in 1948, $3.00.

Chicago, Ill. EUGENE B. HOLMES

"That's you right there, Jackson."

Demere Gives Equations

LOOKING THROUGH our notes, we believe the following rule will be of some assistance.

Velocity of air required in feet per minute should be 850 × $\sqrt{}$ Weight of material per cu ft

Cubic feet of air per cu ft of material equals 1220.

1220 × 7 cu ft = 8540 cfm

850 × $\sqrt{}$ 40 = 850 × 6.321 = 5,372.85 which is the critical velocity necessary to convey the material.

Now we have 8540 cfm at a velocity of 5,372.85 fpm, and we will select a static pressure of 10 in., or 5.768 oz, and looking at the tables we find that a Boyley "B" Exhauster No. 45, driven at a speed of 1186 rpm, will handle 9020 cfm with an outlet velocity of 5500 fpm and require 26.11 hp.

We would like to suggest that a well designed chain conveyor to convey the saw dust and hog chips to the boilers and to the fuel storage, and driven with a small steam engine or variable speed motor, make a job that is almost foolproof and will last a long time.

Steam jets or eductors will convey the saw dust but they will require a lot of steam; as to the moisture added, we believe that would flash off. As a rule, a small stream of water runs on the main band saw which wets the saw dust.

We do not think steam jets or eductors would heat the pine saw dust enough to start the resins flowing.

Memphis, Tenn. C. DEMERE

Answer to No. 514

What Caused Water Level Irregularities?

Holt Answers

BREAKING OF THE FEED pump piston and incorrect action of the feedwater flow meter were separate matters not related to boiler trouble (in M. E. R.'s own words, the same trouble with the meter had occurred "many times before").

Boiler trouble was caused by the partly closed non-return valve, which caused throttling and a pressure drop between the boiler and steam header.

The pump governor held feed line pressure at a constant excess over steam header pressure — not over boiler pressure. At certain times, feed

line pressure was sufficiently higher than boiler pressure to force enough feedwater into the boiler; at other times it was not.

M. E. R. says feed line pressure was equal to or greater than boiler pressure during the trouble. He should consider: (a) equal pressure would not be enough; greater pressure would be needed to force feedwater through control valve orifice, etc.; (b) gages may not have been extremely accurate.

In answer to the numbered questions:

(1) See preceding paragraph. Pump slowed more when difference between boiler and steam header pressures became greater.

(2) Water was going into boilers, of course, but there wasn't enough of it to maintain a correct level in the boiler.

(3) With conditions as described, increase of load would not only remove water from the boiler faster, but would also slow rate at which feedwater entered the boiler. Decrease of load would do the opposite.

(4) See paragraph above, beginning, "The pump governor held feed line pressure . . ."

(5) Meter was faulty.

Ocean Grove, N. J. ARTHUR HOLT

Comments by Moulton

M.E.R.'s TROUBLE SEEMS to be due to the sticking non-return valve, which neither stuck shut nor opened wide; neither did it stay in any one fixed position, but fluttered through a narrow range of openings. This restricted opening caused low and variable steam line pressure, while causing boiler pressure to build up, thus causing safety valves to blow. Boiler feed pumps slowed down because of reduced pressure in steam line and increased boiler pressure.

The following are answers to questions which bothered M.E.R.'s operators:

(1) *Why did the pump discharge pressure show equal to or above boiler pressure when pump slowed down?*

Answer: Piston steam pumps have piston area in excess of water piston area allowing pump to deliver water against higher pressure than that of steam line.

(2) *What was happening to water that was being pumped (if any) when differential governor was being operated by reduced line steam pressure over a differential of the normal boiler drum pressure?*

Answer: Apparently enough excess pressure was applied to governor to keep some water going to boiler, otherwise water would have disappeared entirely.

(3) *Why did water leave the glass, then come back in a few minutes later and pump speed did not increase due to the steam line pressure?*

Answer: There was a pressure variation in both drum and steam line due to changing position of non-return valve. At times there was a change of pressure from 187 to 173 or a drop of 14 lbs, when safety valve blew. The increase of pressure increased the resistance to flow and also caused water in boiler to "shrink" due to compressive action on steam bubbles. This was followed by a drop of 14 lb due to blow-back, which caused a swell of boiler water and also allowed pump to deliver more water. There are two causes for the swelling of water in boilers when under steam: Drop in steam pressure and increased firing rate. Both result in a boiler action with an accompanying increase of steam bubbles; shutting off fires or increasing pressure have an opposite effect.

(4) *Why was water level erratic?*

Answer: Variation in pressure between boiler and steam line caused changes in rate of feed and the shrinking and swelling of water in boiler as already described.

Pittsfield, Mass. A. H. MOULTON

PLEASE

When submitting questions or answers, be sure that your return address is given. If this is not done, we can neither publish your letter nor make proper payment.

PRACTICAL HINTS AND KINKS

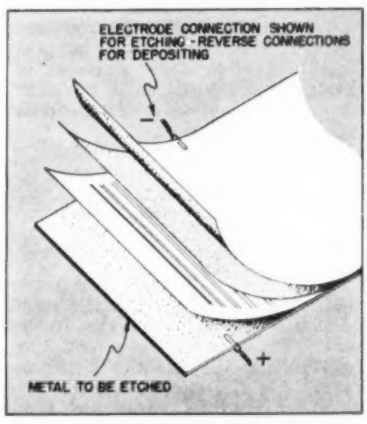
How about the gadget you made or the trick you used to do your job better? Write us about it. Send a sketch too. You will be paid well for contributions.

Mimeograph Stencil for Etching Metals

By ARTHUR K. HIGGINS
Research Department
Allis-Chalmers Mfg. Co.

HERE IS A HANDY way to etch information on metals, especially where the metal is too hard for stamping or scribing, or where a considerable amount is to be etched.

An ordinary mimeograph stencil such as A. B. Dick No. 961 is the key to the process. Type the information you wish to have etched on the stencil with firm uniform strokes. Place the stencil over the metal to be etched, and on top of the stencil place a blotter well saturated with some readily available electrolyte, such as a salt solution. Over the blotter lay a thin sheet of copper. Connect the piece of metal to be etched to the positive terminal of any suitable low voltage d-c source, and the copper to the negative terminal. Avoid excessive current since it will produce too much heat at point of contact.



Simple materials required to etch mimeographed data on metal are (top to bottom) thin copper sheet, electrolyte-saturated blotter and stencil. DC (+) is connected to work piece, (−) to copper

After a few minutes, depending on the current used, the stencil can be removed and the piece will be found to be very well etched. On harder metals such as Vitallium, hydrochloric acid, or hydrochloric and nitric acid in a diluted solution will work more satisfactorily. The stencil can be used repeatedly.

If it is preferred to build up a thin film of metal (raised copper letters) on the surface of the piece to be identified, the positive terminal of the d-c source can be connected to the copper strip and the negative terminal to the work piece.

Step Down a Step-Down Transformer

By WILLIAM G. BRENNAN

IN OUR HOSPITAL we were experiencing very short life of electric light bulbs used in our nurses' call system. Investigation revealed the cause to be high voltage. The system uses 120-v purchased power which feeds through a step-down transformer to energize a so-called low-voltage network (3-phase, 4-wire). Each floor had its own call system and step-down, insulated, secondary-tapped transformer with 120-v input and 24-, 28-, and 32-v taps.

Unfortunately, our line voltage was so high that the lowest secondary voltage we could get was 28 v.

Examination of the taps revealed that the secondary wire itself was brought out for the taps, and that the secondary voltage could be reduced by reconnecting the secondary winding so that the tapped section became a "bucking" winding (see sketch). This produced voltages as low as 16 and 20 v, which greatly increased the life of the lamps and reduced the labor involved in constantly changing them.

We have replaced no lamps in the three or four weeks since the change. Previously, we replaced about 40 each week. The brightness of the lamps was reduced, of course, but this is not critical. The lamps need only to be bright enough to be seen.

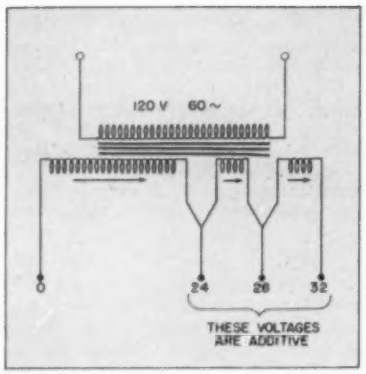


Fig. 1. Original transformer hook-up, additive coils

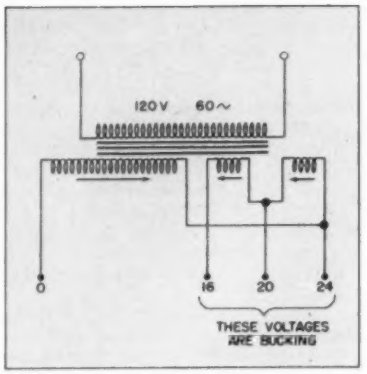


Fig. 2. Reconnected transformer with "bucking" coils

Short-Stopping Selenium Rectifier Troubles

By L. W. FITZPATRICK

EVERY SELENIUM rectifier should be checked monthly to ensure best service. Very little, if anything, can be done for selenium rectifiers after they fail, but periodic checks will detect conditions which cause failure and also give warning of impending failure. The following checks serve these ends.

A high-range ohmmeter check for d-c resistance should be made in one direction, then repeated with reversed leads to give two resistance values. Good rectifiers will show almost infinity on one test and less than 100 ohms in the other direction.

Rectifier temperatures should never exceed 95 F. Check for overvoltage in excess of maximum rating, which can damage rectifier and overheat unit. Past overheating will be shown by small solder beads on disk undersides. Rough blemishes like blisters near pressure washers and on the selenium coatings will show where selenium has shorted through. "Smell" testing will rapidly indicate where the selenium has been damaged because a pungent gas is liberated by heated selenium.

With the normal rectifier rating given at 95 F, its rating drops to 65 per cent at 131 F.

Check volt-ampere efficiency with an a-c wattmeter and a moving-coil d-c voltmeter and ammeter. Efficiency should be between 65 and 85 per cent, depending on the circuit. The load curve should be flat between 20 and 85 per cent.

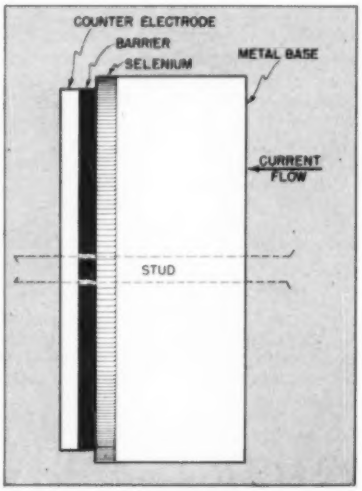
Single phase selenium units connected to capacitor or battery load are usually de-rated about 20 per cent for high rectifier current against average current value.

Aging increases rectifier resistance, reducing the d-c voltage output from about 5 to 10 per cent, depending on service. Rectifier transformers usually have taps to increase the a-c supply as the rectifier ages. This aging effect obviously lowers efficiency. Current and voltage unbalance may occur when new rectifiers are connected to aged stacks because forward and inverse resistances are different.

Check for corrosive fumes which can attack selenium. In corrosive atmospheres, rectifiers can be immersed in oil. Continuing the check, look for mechanical damage and shorts through the frame or support to ground. Test each terminal to ground. Excessive dirt or moisture can cause lowered resistance in stacks and cause short circuits.

If a selenium rectifier has been idle for a long time or has been operated at a low inverse voltage, inverse resistance has decreased. When full current is applied, the inverse current will be abnormally high for several minutes until normal resistance returns. When returning to service after such a period of inactivity, rectifiers should have voltage applied gradually.

When rectifiers are specified for intermittent service, this caution should be strictly heeded. Intermittent units operated continuously will deteriorate rapidly and give poor service as well.



Typical cross-section of selenium rectifier assembly

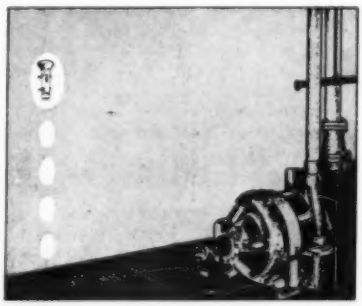
Lights When the Lights Go Out

By ROBERT JAMES

IN LARGE PLANTS, and many small ones, a battery-operated emergency lighting system automatically comes on when power failure blacks out the plant. In smaller plants, however, it is uneconomical to install such a system for the infrequent usage it receives. For these plants, I suggest an extremely simple and fool-proof installation consisting of flashlights and phosphorescent paint.

At the ends of aisles in the plant, paint circles of phosphorescent paint about chest-high on the walls. In the center of each circle, screw mounting brackets for the flashlights to the wall. When the lights go out, operators can find an aisle and then "follow the beam" to the emergency lights. Locating the lights at the ends of aisles will save a lot of barked shins.

As extra insurance against falling over unseen objects in the aisles, paint round spots of "glow paint" all the way to the floor under the flashlights. Large objects in the aisle will show up against the spots.


Glowing paint spots at the ends of aisles show a blacked-out plant operator location of flashlight

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Gage Glass Erosion Attributed To Alkalinity

By F. A. BENGER
Chief of Motive Power and Rolling Stock
Canadian Pacific Railway Co.

NOT LONG AGO we encountered a problem on gage glass erosion in tubular water glasses on steam locomotives. This problem was so severe that replacement was required every seven days — the glasses having failed.

During the investigation of this problem, a thorough search of literature failed to provide any pertinent information in determining the cause of glass wear. Extending the investigation, however, results were obtained that led to the solution of our own problem and which might be of help to others with conditions similar to ours.

Reduction of gage glass thickness was experienced in two places. The exterior surface on the upper and lower portions extending beyond the gaskets were worn, the wear on the upper portion being the most severe by far. Of the utmost importance, however, the entire inside surface of the glass was worn. While there are a number of factors which contribute to this erosion, it was proved to our satisfaction that the most important factor was boiler water alkalinity — primarily due to chemicals used for water softening.

Comparison Samples Taken

During our investigation, water samples were obtained from the gage glasses of engines in operation under two conditions. The first condition was with our standard water glass mounting arrangement where both top and bottom mountings went directly into the back head of the boiler. The second condition was created by blanking-off the top mounting and extending a pipe from the top of the water glass over the fire box and into the steam space of the boiler. The first arrangement is shown in Fig. 2 and the second is shown in Fig. 3.

In the first case, it was found that the boiler water was quite alkaline. In the second case, the alkalinity was reduced almost to zero. This is attributed to the fact that the extended pipe acted as a condenser and its discharge through the water glass was essentially distilled water.

Unique Sampling Device

Considerable difficulty was encountered in obtaining satisfactory samples. This problem was finally overcome by a rather unique device which was designed solely for extracting samples from water glasses. The sampling device (Fig. 1) consists of a thin copper tube and valve assembly and is installed in the top mounting with a threaded fitting. The tube extends down inside the water glass almost to the bottom mounting. To take a sample, the bottom mounting valve is closed and then the sampling thief valve is opened slowly. Boiler pressure forces the sample out the inverted U-tube. This sampling device (comparatively simple when finally developed) was of considerable help in confirming our theories.

Development of the modified mounting arrangement was brought about by special conditions observed during the tests. It had been shown that locomotives equipped with a water column did not experience the accelerated gage glass wear since the water column acted as a reservoir of condensate rather than boiler water.

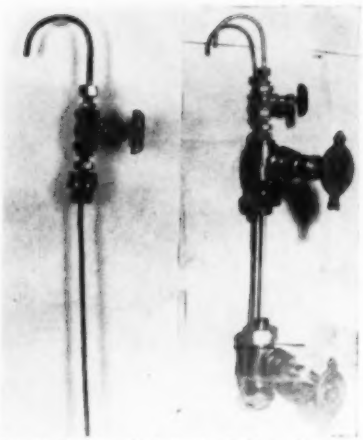

Fig. 1. Sampler thief device (left) is shown at right as it is installed. Note tube inside glass

This presented us with a rather grim picture as the water column was not used on any of our locomotives and in some cases could not be applied. Furthermore, such an arrangement would be very expensive to apply. The final solution (Fig. 3) required only minor changes in our standard set-up, but in effect gave us the same desired conditions. As a result, it has been made standard on all our locomotives and, for the past two years, has prevented difficulties arising from gage glass erosion.

Conclusions

From this test it was concluded that reduction in thickness of water glasses results from the alkaline boiler water, and that when wear was not encountered, it was because the water in the gage glass was essentially condensate rather than boiler water. Furthermore, various makes of water glasses representative of those used throughout the country were examined and it was found that erosion rates were uniform for all practical purposes.

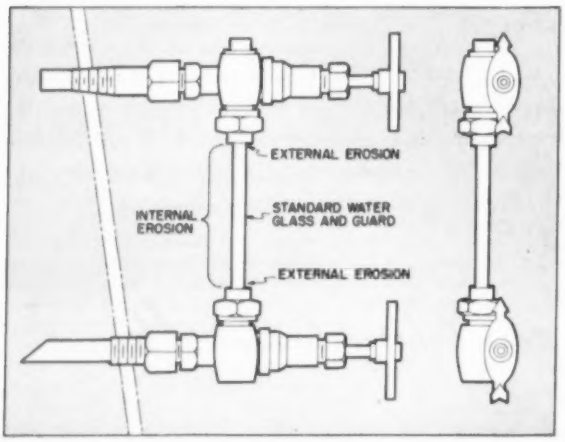

Fig. 2. Original standard arrangement of locomotive water gage glass mount

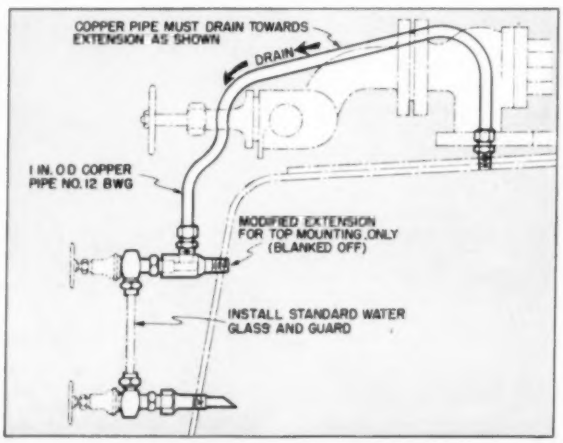
COPPER PIPE MUST DRAIN TOWARDS EXTENSION AS SHOWN
DRAIN
1 IN. O.D COPPER PIPE NO. 12 BWG
MODIFIED EXTENSION FOR TOP MOUNTING ONLY (BLANKED OFF)
INSTALL STANDARD WATER GLASS AND GUARD

Fig. 3. New standard mount showing modified top mount and condenser pipe

Single wrench maintenance

check these time and money-saving maintenance features

1

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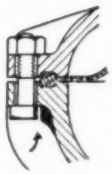
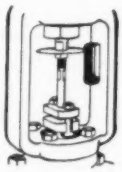


2

WIDE YOKE—plenty of room for big hands to work with that one wrench.

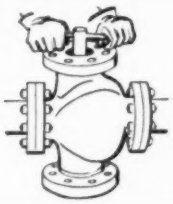


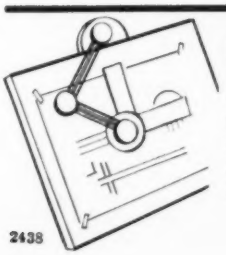
3

FLATS on valve stem use same adjustable wrench—does not score stem.

4

SEAT RINGS can be renewed without taking the valve body from the line. No vises, no lathes. Standard Leslie practice for 27 years, not a theory, a proven fact.





5

INTERCHANGEABLE parts keep inventory small, reduce down-time. Top grade materials and engineering means less maintenance.

2438

There are a host of important features found as *standard* in Leslie Double-Seated Diaphragm Control Valves usually manufactured only in "made-to-order" units — features that mean *top* performance and *extra*-dependable service.

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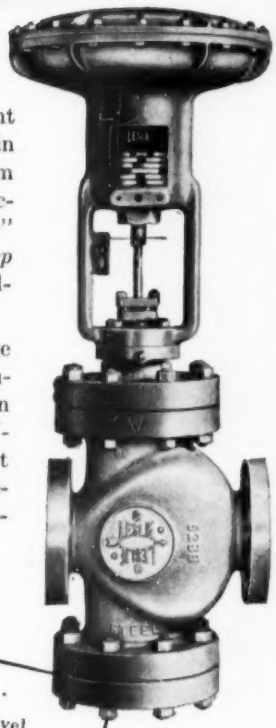

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Cases in Smoke Abatement

The Elusive Fly Ash

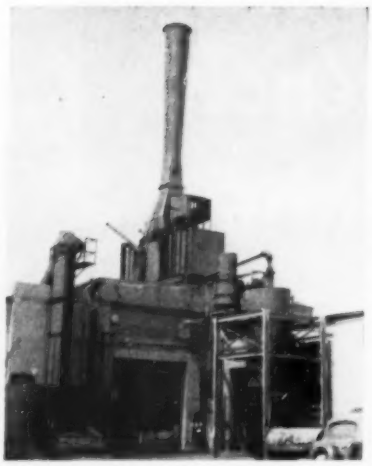
By C. W. GRUBER
Chief Smoke Inspector
City of Cincinnati

A 300 HP 3-drum water tube boiler was installed in 1948 in a corrugated paper mill, as an alternate boiler for an oil-fired unit which was slightly under sized. The new boiler was fired by a pneumatic spreader stoker, having a maximum burning rate of 1600 lb of coal per hr. The boiler installation was very complete, incorporating coal handling, automatic combustion control, induced draft fan with high efficiency fly ash collector, as well as over-fire air unit. This job appeared to have "class," but there was no ash handling system.

When the job started in June of 1948, the ash handling was by the "heave-ho" method. The collector hopper on the fly ash separator was drained daily into 55-gal steel drums and stored for removal by truck. Fifteen such drums were filled with fly ash every day. The drums were then man-handled on to the truck with dust flying everywhere. In order to save excessive labor, and to eliminate dust from blowing back into their own plant, a steam jet conveyor system was designed to blow the ash into an outdoor tank. The system was installed during the '48–'49 winter, and on the first nice spring day the fly ash complaints commenced.

Analyzing the conveyor and tank system, it was found that it constituted an efficient fly ash classifier. The coarse material fell into the tank, and the fine, light, troublesome sort of ash went out the stack and over the neighborhood. The breeching loaded up to the point where the fly ash collector became ineffective.

So after many complaints, another change was made. This time,



Exterior view of power house showing coal elevator on left, dust collector and ID fan on roof, and ash tank and dust collector of ash system at right. Coarse ash fell in tank, fines up stack

through the insistence of the BSI, a properly designed washer was installed on the exhaust from the cinder tank and the return from the conveyor system was removed from the stack. A water spray was installed at the tank unloading gate. This system worked fine until winter.

On the first zero day, the conveyor line froze up and stopped the entire system. However, after a minor correction was made permitting the line to drain properly, the system could be operated even in sub-zero weather. The entire system is now operating well, and all complaints have ceased.

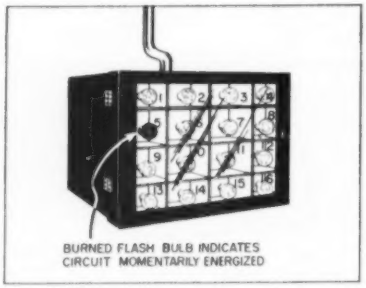
The lesson to be learned from this job is very important. No solid fuel burning job is complete until provisions are made for removing the ash from the premises. There is really no benefit in separating ash from flue gases if, in the handling of the ash, it is blown out over the neighborhood a few hours later.

Identifying Alarm Circuits

By PAUL C. ZIEMKE

ONE POPULAR TYPE of fire alarm for industrial plants connects with an annunciator box at a central point so that the plant firemen can determine the exact location of the fire before starting out with their equipment. The annunciator consists of a bank of 10-watt lamps located under a glass bezel fitted in a metal door on the box. Each lamp is numbered to correspond with a location.

An aggravating series of alarms came through one such device — aggravating because no light was burning when the firemen arrived to determine where the fire or faulty circuit was located. On each run, a complete survey was made of the building to be certain that no fire had been overlooked. In this case,



BURNED FLASH BULB INDICATES CIRCUIT MOMENTARILY ENERGIZED

they were all false alarms caused by a defective alarm circuit — but which?

While the speculation was going on, a bright boy known as an accomplished photographer came forward with this suggestion: Replace the 10-watt bulbs with flash bulbs, which also have the Edison type base.

The suggestion was adopted and put into effect. The next false alarm that came in was easily traced.

Explanation of . . .

Curves for Figuring Losses

THE CURVES for figuring steam losses due to jets or leakage appearing on page 94 can be used to calculate the largest quantity of steam which can flow through any form of opening, nozzle, orifice, etc., when the pressure on one side of the opening is about half or less than the pressure on the other side. (Specifically, the critical pressure ratio for saturated steam is 0.578.)

When the pressure ratio exceeds this critical figure, the maximum possible velocity of escape has been attained, thus the amount of steam being passed through the opening under such conditions becomes a function of the area of the opening and the density of the steam. While increasing the initial pressure will not increase the escape velocity, it will increase the density of escaping steam and, thereby, the amount of steam lost.

To determine the steam losses, then, it is necessary to measure:
(1) The steam pressure (psia);
(2) The steam temperature (deg F);
(3) The area of leakage or opening (sq in.).

When these factors have been measured, enter Part I of the chart with the steam temperature. For superheated steam, it is necessary to follow a horizontal line from the temperature to the point of intersection with the steam pressure. For saturated steam, follow a horizontal line from the temperature to the "Saturated Steam" line. Drop a vertical line from the point of intersection downward into Part II of the chart where it will intersect a line designating the leakage area. A second horizontal line from this point to the right will intersect the ordinate at a figure corresponding to the steam loss in lb per hr.

Dotted lines in Part II of the chart indicate circular areas for pipes or jets from $\frac{1}{16}$ to 1 in. in diameter.

The curves were constructed around points determined by the following formula:

$$L_L = KA_L\sqrt{PG}$$

where: L_L = Steam loss through opening (lb per hr)
K = Factor for saturated steam (1085)
for superheated steam (1138)
P = Steam pressure before the opening (psia)
G = Specific gravity of steam before the opening (lb per cu ft)
A_L = Leakage area (sq in.)

It is recommended that the formula rather than the chart be used when the conditions being studied are outside the range of those conditions given in the chart. Interpolating or extrapolating can lead only to approximate answers.

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Learn all about the basic types and differential pressure ranges in which the Ashcroft Pneumatic Transmitter with Differential Pressure Cell can be supplied. Write for Bulletin 330.

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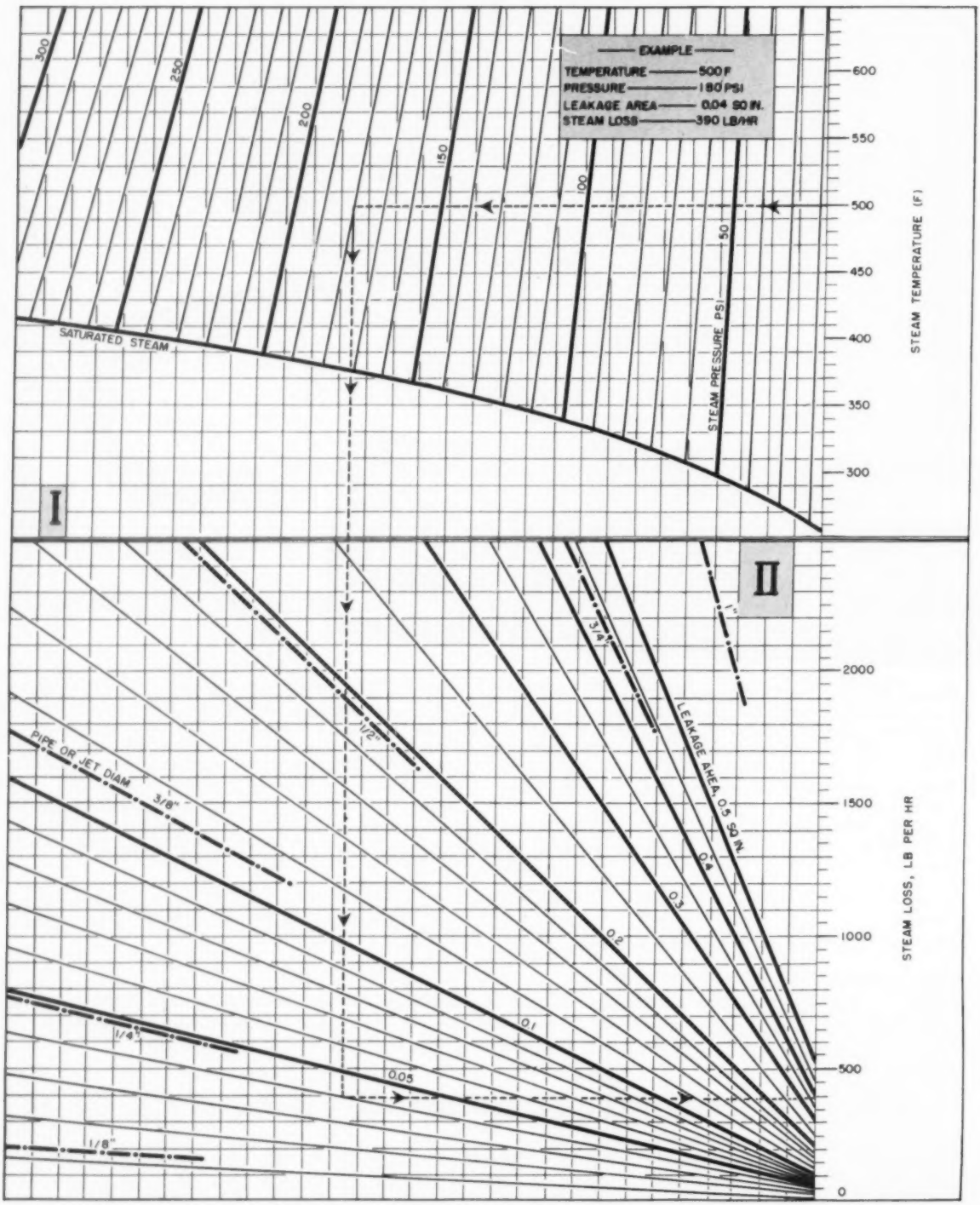
Curves for Figuring Steam Losses Due to Jets or Leakage

If you know your steam pressure and temperature and can determine the area of leakage or jet opening, you can use this chart to establish the steam lost through leaks, jets or even safety valves. Refer to page 92 for rules governing use of the curves and for the formula on which they are based



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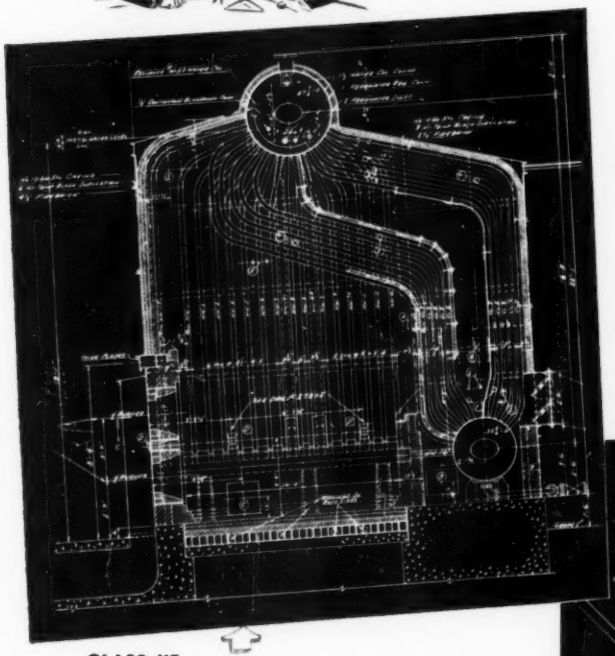
Industry Approved

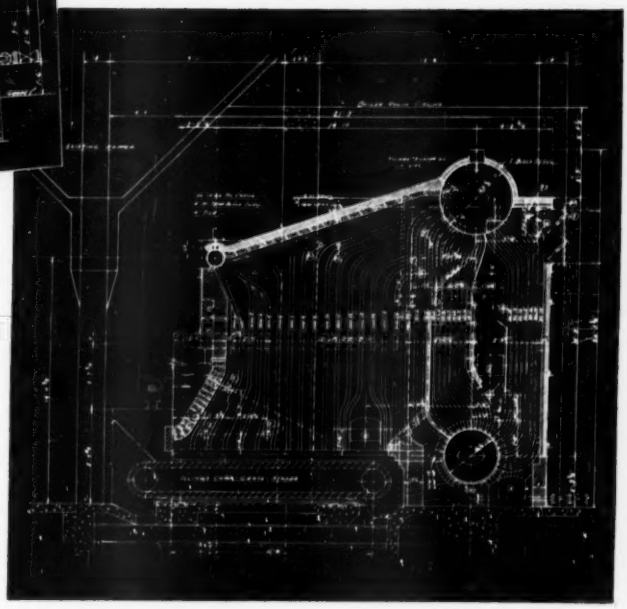
Two-Drum

STEAM GENERATORS

by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
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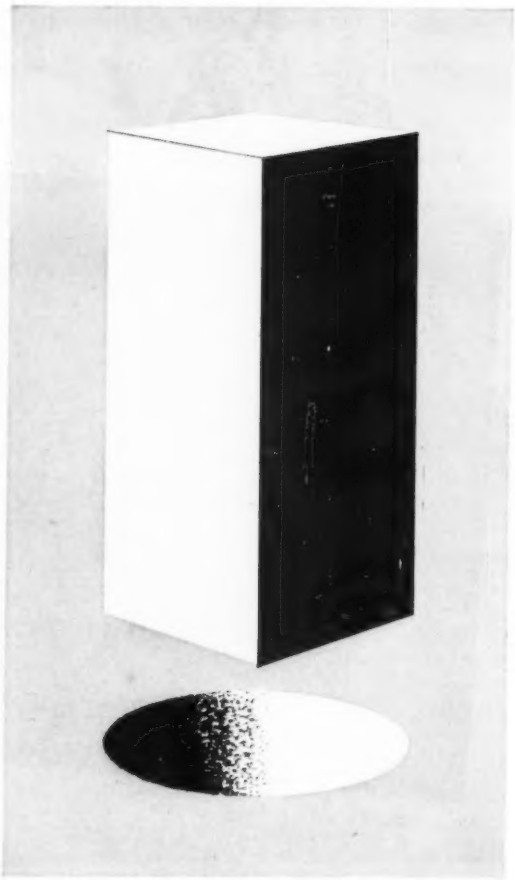

SQUARE PEGS IN ROUND HOLES

The proverbial "square peg in a round hole" is an apt description of a system of Automatic Combustion Control and Instrumentation which is not engineered correctly for your plant requirements.

Avoiding such a condition calls for versatile, durable and accurate components, plus the "know-how" acquired from experience with thousands of installations of virtually every imaginable type.

Larger boilers, operating at higher pressures than ever before, and the increasing use of multiple fuel systems, make a properly engineered instrumentation and control system an urgent necessity.

A fundamental requirement in the design of the units which comprise Hagan systems is that they must be versatile, accurate and dependable. These characteristics are built into every unit of the wide variety available to Hagan engineers for designing systems of Automatic Combustion Control and Instrumentation to fit exactly the requirements of *any* steam plant.

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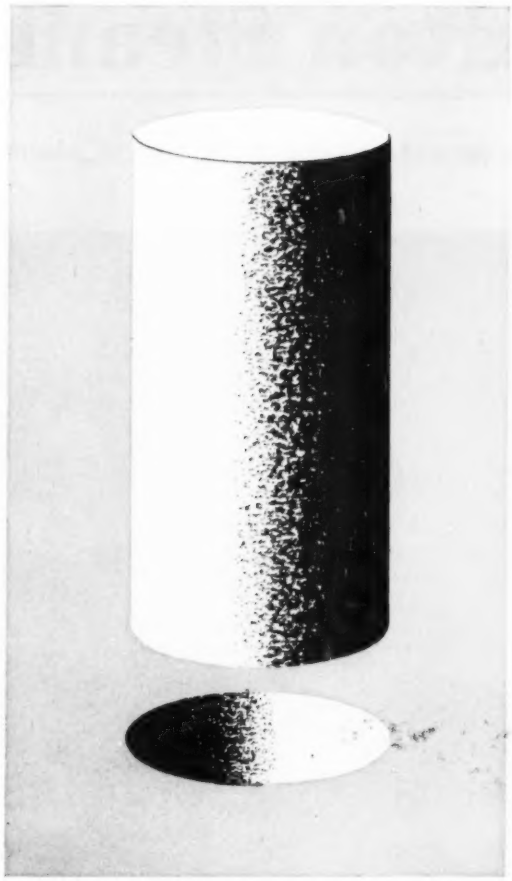
HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS

INSTRUMENTS AND AUTOMATIC CONTROL SYSTEMS



TAILORED TO FIT

For the past thirty-five years, Hagan Corporation engineers have designed systems of Automatic Combustion Control and Instrumentation tailored to fulfill the requirements of thousands of plants. In fact, for any set of operating conditions, for any size or number of boilers, for any combination of fuels, there is a system of Hagan controls in successful operation.

To implement the engineering skills derived from such diverse experience, Hagan engineers have a wide variety of versatile, accurate and dependable units from which to choose. For example, typical Hagan units are shown at right.

Whatever your requirements, in terms of pressure, temperature or load fluctuation, a Hagan System of Automatic Combustion Control and Instrumentation assures maximum combustion efficiency. Write or call . . .

METERS—To measure differentials to 560" WC at static pressures up to 3,000 psig and differentials to 140" WC at static pressures up to 15,000 psig. Accurate automatic compensation for such factors as pressure and/or temperature, level, density is a standard attachment.

CONTROL—For a continuous range of pressure from zero absolute to 5,000 psig.

POWER UNITS—for dampers and valves. Powerful, high speed, fast response.

PANEL RELAYS—for biasing, manual-automatic or ratio adjustments—and requiring minimum panel space.

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

METALLURGICAL FURNACE CONTROL SYSTEMS • CONTROL SYSTEMS FOR AUTOMOTIVE AND AERONAUTICAL TESTING FACILITIES

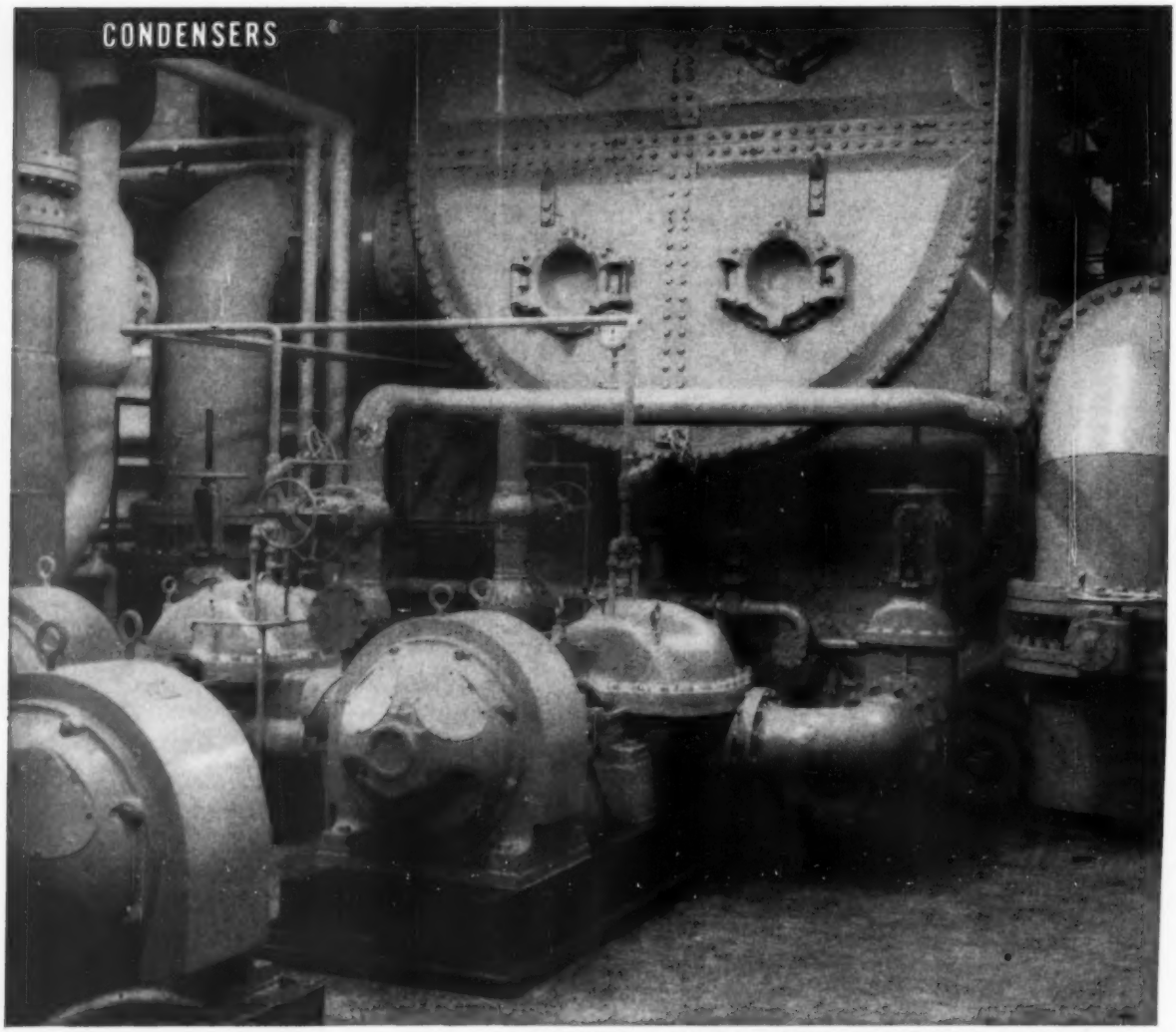
HAGAN HALL BUROMIN CALGON

MUST BE VERSATILE • ACCURATE • DEPENDABLE

For more data circle 539 on Post Card

Worthington Steam

News and information about Worthington equipment for the steam power plant



WORTHINGTON'S 37,500 SQUARE FOOT CONDENSER at Columbus and Southern Ohio's E. M. Poston Station

Shallow wells supply all water for this Worthington-equipped power plant

The E. M. Poston Generating Station of the Columbus and Southern Ohio Electric Company, presently rated at 200,000 kw, gets its entire water supply from shallow wells 7000 feet away from the plant site. A 40-million gallon reservoir stores well water for emergency use.

Worthington equipment at the Poston Station now includes 3 condensers with all auxiliaries, including steam-jet ejectors, circulating water and condensate pumps—also deaerators, evaporator preheaters, and miscellaneous equipment.

Worthington, with over a century's experience in the manufacture of steam power equipment, is equipped to build efficient condensers in sizes to suit any practical limitations. Recently, the largest single-shell condenser in the world—125,000 sq. ft.—was made by Worthington for a large utility.

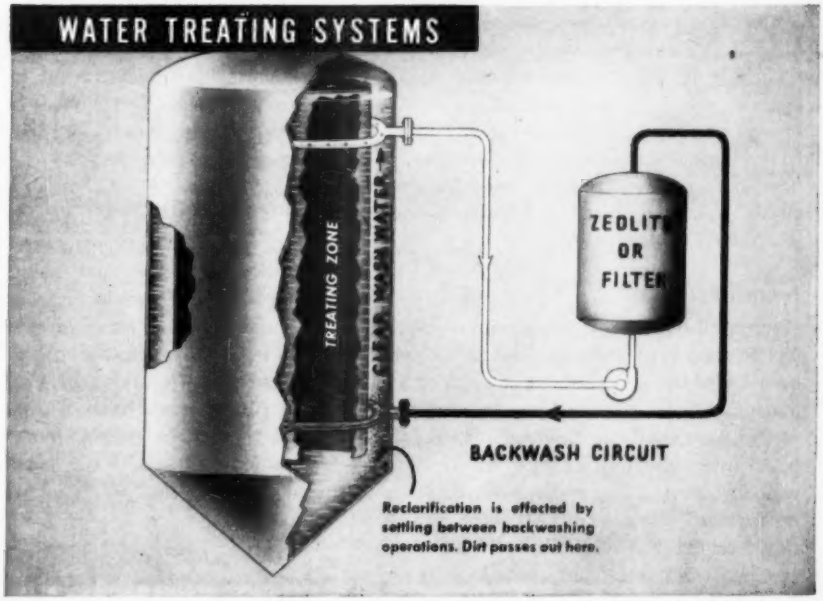
Power Bulletin

Condensers, deaerators, water-treating systems, and steam-jet ejectors and vacuum pumps as well as turbine generators, mechanical drive turbines and gears, circulating, condensate and boiler feed pumps, pressure filters, and air compressors.

You can't wash clean with dirty water!

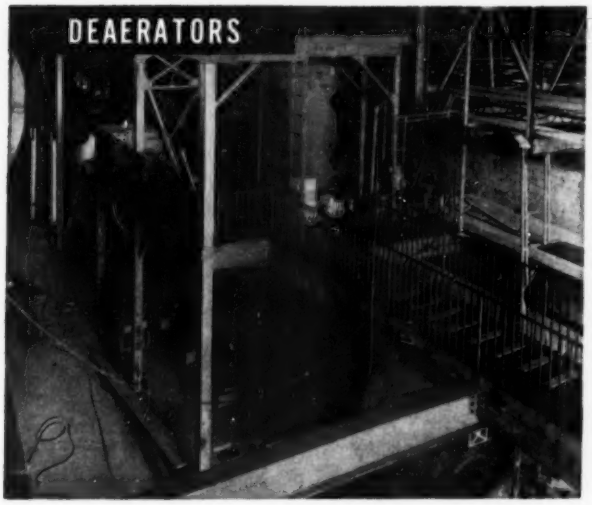
Every Worthington standard Hot-Z or conventional system provides exclusive, *independent* facilities for backwashing zeolite or filters with clean, hot, chemically inert water, without disturbing the normal flow through the reaction tank.

This unique backwashing provision is just one of many Worthington exclusive features, but it alone more than justifies the selection of a Worthington system for hot-processing boiler feedwater in your plant.


WATER TREATING SYSTEMS
TREATING ZONE
CLEAN WASH WATER
ZEOLITE OR FILTER
BACKWASH CIRCUIT
Reclarification is effected by settling between backwashing operations. Dirt passes out here.

BACKWASH FLOW CIRCUIT IN WORTHINGTON HOT-PROCESS SYSTEM shows how *independent* built-in annular wash-water compartment* provides clean, hot, chemically inert water for backwashing.

*Reg. U.S. Pat. Off. 2,263,398



Dayton installs its newest Worthington deaerator

Worthington has supplied the deaerators for each new Dayton Power and Light Company installation since 1936. This new deaerator being installed at the O. H. Hutchings Station, in southwestern Ohio, is one of many Worthington units built in sizes to handle from a few thousand pounds per hour to over a million. Both tray and steam-jet types are made, with external surface-type vent condensers or internal direct-contact vent condensing. With a complete range of sizes and types at their fingertips, Worthington engineers can give you a deaerator exactly suited to your needs.

S.3.18

Get in touch with your nearest Worthington district office for bulletins and information. Or write to Worthington Corporation, Steam Power Division, Section S.3.1, Harrison, N. J.

WORTHINGTON

For more data circle 540 on Post Card

Service . . . *where and when you want it*

PROMPT, experienced service is one of the most important plus values you get when you buy Honeywell instruments. An unequalled organization of trained specialists is always at your call at more than 110 offices in the United States and Canada. Offices are located in practically every large industrial city of the country . . . close to every major production center.

Trained Personnel

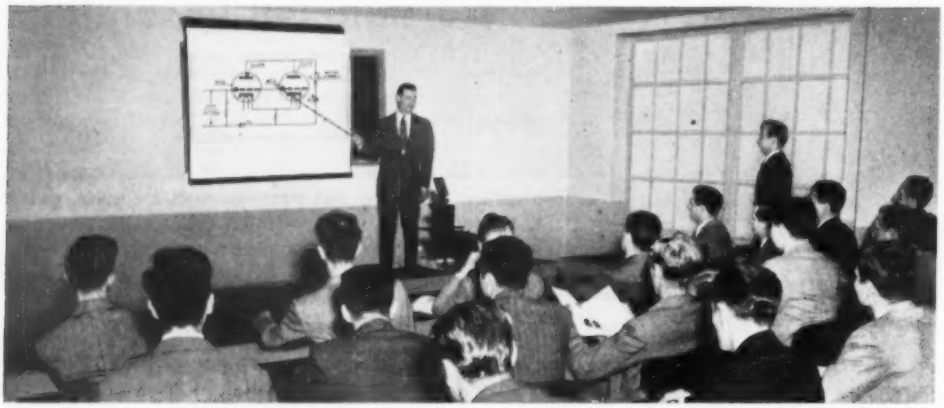
Honeywell service men are schooled not only in the theory of measurement and control, but also in the practical art of keeping good instruments in the best condition. Hand picked men begin this instrument education in an intensive training program in Honeywell factories. After graduation, they serve an apprenticeship in the field offices . . . while they learn still more about instrument maintenance from first-hand contact with plant problems. By the time a Honeywell man arrives at your plant on a call, he's a finished product worthy of the responsibility he bears, and capable of doing the kind of service job that you need . . . and that your Honeywell instruments deserve.

When trouble strikes, a wire or telephone call will bring a service man to your plant . . . often within a few hours. This assurance of prompt action means a lot to your production schedules. You'll never be left out on a limb because of delays in instrument maintenance.

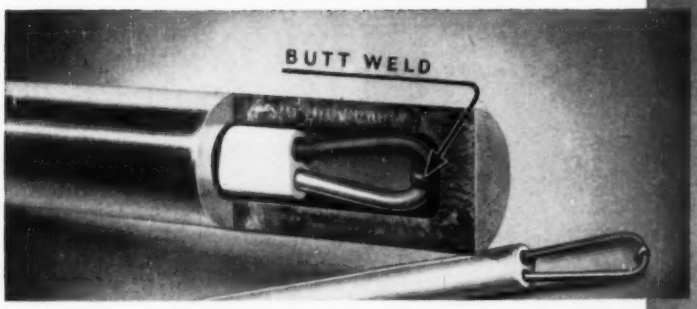
Periodic Service Plan

But why wait for emergencies? Preventive medicine works on instruments, too. And the prescription is simple . . . a Periodic Service Contract, which brings a Honeywell service man to your plant at regular intervals to inspect, clean and adjust any Honeywell instruments you have. The plan is economical . . . can save you many hours of lost production time. Your nearest Honeywell office will be glad to give you full details.

A faster, stronger *for steam*



TRAINED TO SERVE: *In Honeywell's service school, students get a thorough grounding in instrument theory and practice. After graduation, they become part of the most extensive organization of its kind in the world . . . ready to serve you competently and promptly, whenever and wherever you need them.*



FOR getting high-speed, precise measurements of steam temperatures, the Brown butt-welded thermocouple is the ideal partner for *ElectroniK* instruments. This thermocouple's unique characteristics come from an entirely new kind of design, in which the two couple wires are electrically welded together in a butt joint.

The thermocouple is *faster*—because the mass of the junction is much smaller than the usual twisted joint. It's *stronger*—withstands vibration and shock better. And it's *more accurate*—because the loop formed at the joint prevents heat conduction from the junction back to the insulators.

A wide line of thermocouple wells is supplied for various steam plant applications . . . including a series especially designed for high pressure steam lines. All Brown thermocouple wells are precision-machined to highly uniform wall thickness, to guarantee dependability at high temperatures and pressures. They are available in a broad choice of standard sizes and designs, supplemented by special types made to individual specifications.

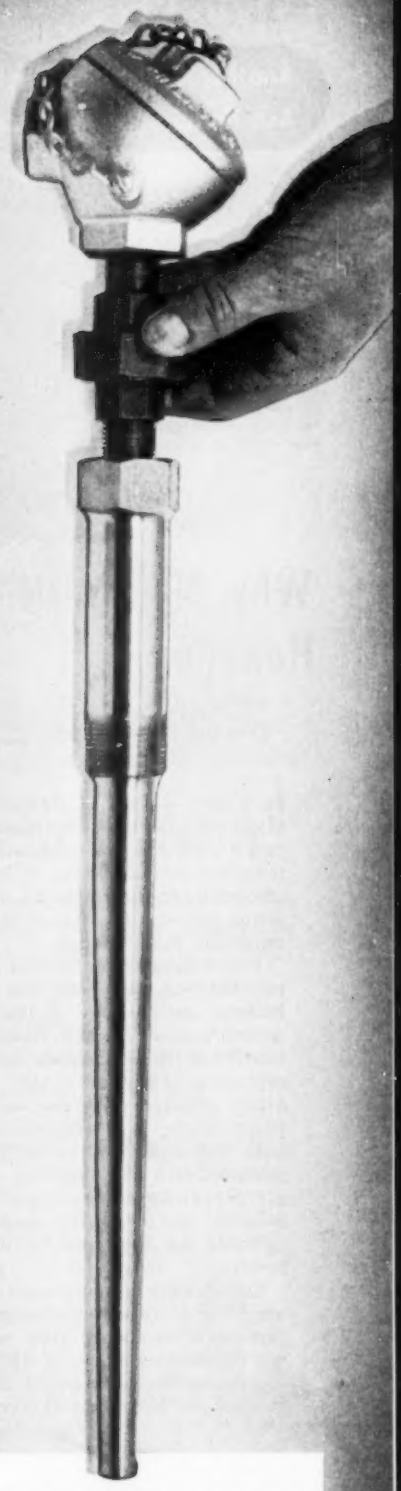
thermocouple *plant temperatures*

For specifying and purchasing all instrument supplies and accessories, you'll find new convenience and economy in the Honeywell Supplies Man—HSM—Plan. Your local HSM will be glad to explain the plan in detail, and to show you how planned buying can save you time and trouble. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa.

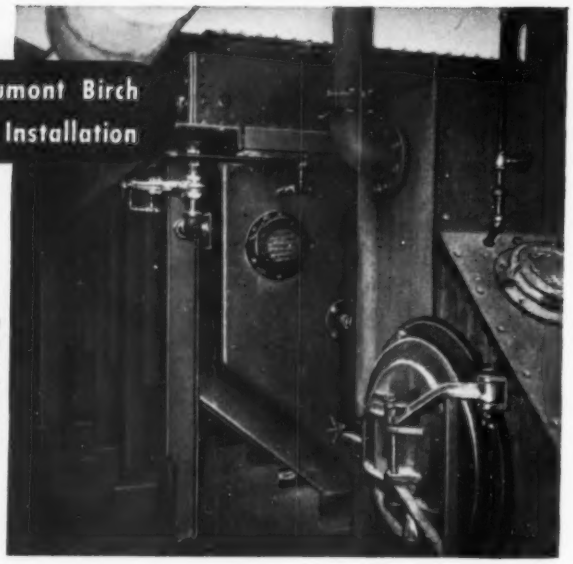
REFERENCE DATA: Write for Pyrometer Supplies Buyers' Guide No. 100-4 . . . and for Specification Sheet No. 200-2 on Thermocouple Wells.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



STEAM THERMOCOUPLE *has tapered stainless steel well, precision-drilled to highly uniform wall thickness. Inset shows butt-welded thermocouple junction. The small mass gives fast response . . . curved wires prevent heat conduction away to the insulators.*

Another Beaumont Birch Ash Handling Installation



Discharge end section of a flooded hopper for Beaumont hydraulic system showing rugged supporting structure and circular protected observation ports of special heat resistant glass.

Why BEAUMONT BIRCH Hydraulic Ash Handling Systems Assure You

Reliable, Efficient Service

In every detail of Beaumont Hydraulic Ash Handling Systems, you'll find they're designed for practical considerations of boiler efficiency, operating safety, minimum man-hour attention and minimum maintenance.

For example, on flooded hoppers beneath pulverized coal fired boilers, costly shut downs are never necessary when water jet nozzles in the ash hopper require replacing. They are easily and safely replaced *while the boiler is in operation* . . . the rugged sluice gate and operating cylinder are mounted on a single casting, completely shop assembled. This assures perfect alignment of cylinder for long uninterrupted service.

On flooded hoppers, operators are always protected at observation ports by special glass resistant to thermal shock, in addition to a protecting metal guard. Built-in spray washers keep all observation ports clean and free from dirt and fog.

These and many other points, such as, sluiceways, sumps, dewatering bins, flyash handling systems and other supplemental equipment are only a small part of the attention to details that are characteristic of Beaumont Birch Systems.

Power and Consulting Engineers specify Beaumont Birch Hydraulic Ash Handling Equipment because they are assured of design, engineering and construction to exacting specifications!

Beaumont's background of over fifty years in the design and manufacture of ash handling systems gives you long service life with a minimum of maintenance.

For complete details of the many efficiency and economy features of Beaumont Hydraulic Ash Handling Systems, call in a Beaumont Birch engineer or write direct.

Beaumont BIRCH COMPANY

1503 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—BULK MATERIAL HANDLING SYSTEMS

For more data circle 542 on Post Card

Refrigeration Dollars

(*Continued from page 67*)

by air entering from the outside when doors were opened or when fresh products were being placed in storage, this was not the whole story.

All rooms, other than the freezer which was carried at zero and below, were provided with floor drains. Of all those provided, only two drains were equipped with traps. From the floor to the outside, the size of the drains was 4 and 6 in. When a lighted candle was held over the floor openings immediately above the drain pipe, its flame was deflected downward and sometimes was extinguished altogether, showing that there was a column of cold air continuously flowing from the room through the drain pipe to the outside. Naturally, an equal amount of warm, moisture-laden air flowed into the room to take its place. This condition is one that not only aggravates frosting, but represents considerable loss in capacity. See Fig. 3.

Since conditions prevented installation of the usual floor traps, it was necessary to provide a loop seal (Fig. 2) on the end of the main drain to which all rooms were connected and which terminated in a large manhole about 50 ft from the building. This loop prevented any air leakage from the rooms, thereby reducing frost formation and loss in refrigeration.

Choose Right Burners

(*Continued from page 80*)

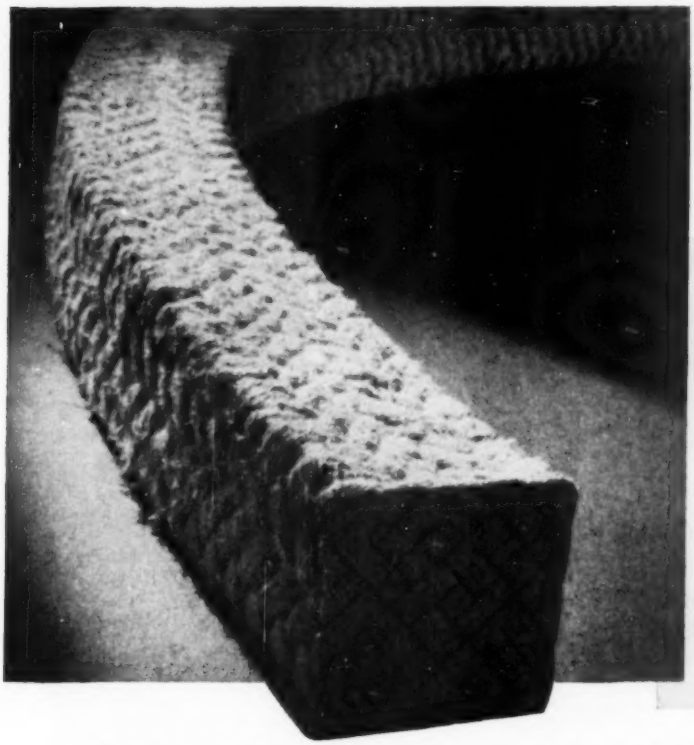
from the rear over spreader stokers in each of three 60,000-lb-per-hr boilers. The same forced draft fans and basic combustion controls are used for both fuels.

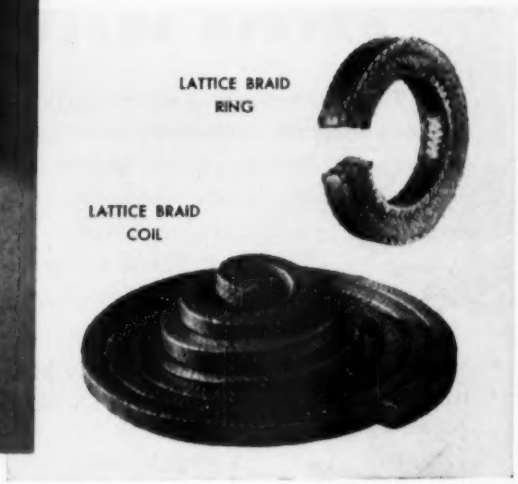
(4) At the National Advisory Council of Aeronautics in Cleveland, (see Fig. 7) and at the Hotpoint Plant in Chicago, we have "In-the-Door" type registers with gas rings and oil guns set in each fire door. No brickwork alternations are required other than protecting the grates. Forced draft air is taken from under the grates, and carried through ducts to the registers in the fire doors. These installations are combined with spreader stokers and the oil and gas burners must be removed to burn coal.

(5) At the Hawthorne Station of the Western Electric Co. (see Fig. 8), we have Todd combined pressure and steam atomizing guns through the center of the Riley pulverized coal registers, four per boiler, each burner with a capacity of 60,000 lb of steam per hour.

These are typical applications. There are others. In many cases, it is necessary to bend the water walls around the registers to fire either above the stokers or through the sidewalls.

Braided through and through for longer service, less maintenance!





GARLOCK LATTICE BRAID* PACKINGS

APPLICATIONS

On rotating shafts, reciprocating rods or rams, expansion joints and valve stems

TYPES OF SERVICES

Water, oil, solvents, acids, steam, gases, etc., at temperatures up to 700° F.

AVAILABLE MATERIALS

Asbestos (Canadian or Blue African)
Asbestos—wire reinforced
Flax
Cotton
"Teflon" or asbestos with "Teflon" impregnation

AVAILABLE FORMS

Ring, coil, or reel

Every strand of LATTICE BRAID packing passes diagonally through the body of the packing to form a completely unified structure—braided internally as well as externally. This patented LATTICE BRAID method has these advantages:

1. Prevents the packings from disintegrating when subjected to wear.
2. Makes the packings flexible so they can be formed into rings without distortion.
3. Allows us to control porosity so that the right amount of liquid is absorbed for lubrication.
4. Imparts a semi-automatic action to the packings. This eliminates the need for frequent gland adjustments.

For complete information send for LATTICE BRAID Folder AD-131. Write the nearest Garlock branch or to our main office.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

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In Canada: The Garlock Packing Company of Canada, Ltd., Toronto, Ont.

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GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS, RUBBER EXPANSION JOINTS

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Have you this LATEST DATA

on the revolutionary

Arnold O. Beckman INC.

OXYGEN ANALYZERS?

Throughout industry — wherever oxygen content of gases influences or controls combustion or firing operations — Arnold O. Beckman Oxygen Analyzers are establishing completely new standards of accuracy, simplicity and convenience. These are the *only* instruments that make a direct physical measurement on oxygen itself — not of some variable secondary relationship.

Have *you* fully investigated the vital savings to be made by this revolutionary measuring principle in *your* operations? Are you aware of the latest money-saving applications for this equipment? If not, send for the following helpful literature. It's free!

BULLETIN 108: *Describes the Model F-3 Beckman Oxygen Analyzer —the instrument designed primarily for industrial applications such as combustion control, catalyst regeneration, sulfur grinding, etc., which requires an oxygen measuring range of 0-5%, 0-10%, 0-15% or higher. Bulletin 108 describes the unique magnetic operating principle used in Model F-3 Analyzers, gives equipment specifications and typical applications.*

BULLETIN AD607: *Contains helpful charts and data on most efficient methods of controlling various combustion processes.*

BULLETIN AD608: *Outlines savings to be made with oxygen control in Cat Cracking operations, gives sampling suggestions and list of equipment.*

BULLETIN AD611: *Contains helpful data on Tunnel Kiln Applications, shows typical installation, details equipment required.*

BULLETIN AD703: *Describes a Gas Sampling System particularly suited for combustion applications in various types of plants . . . illustrates layout of equipment, provides table for selecting sample tubes.*

The above informative literature will gladly be sent you free. For maximum convenience, use the coupon at right.

Arnold O. Beckman INC.
1020 Mission Street, South Pasadena 1, California

Please send Bulletins checked below:

☐ 108 ☐ 607 ☐ 608 ☐ 611 ☐ 703

Name _____

Company and Address _____

_____

_____

Position _____

For more data circle 544 on Post Card

Newkirk Leaves Dow

MERLE NEWKIRK, a member of The Dow Chemical Co.'s Power Department at Midland for the past 38

Merle Newkirk

years and widely known in the power field, has relinquished his responsibilities as department manager. He has reached retirement age; however, he will continue to serve the department as a consultant.

Macauley Whiting has been appointed as Midland Division power

Macauley Whiting

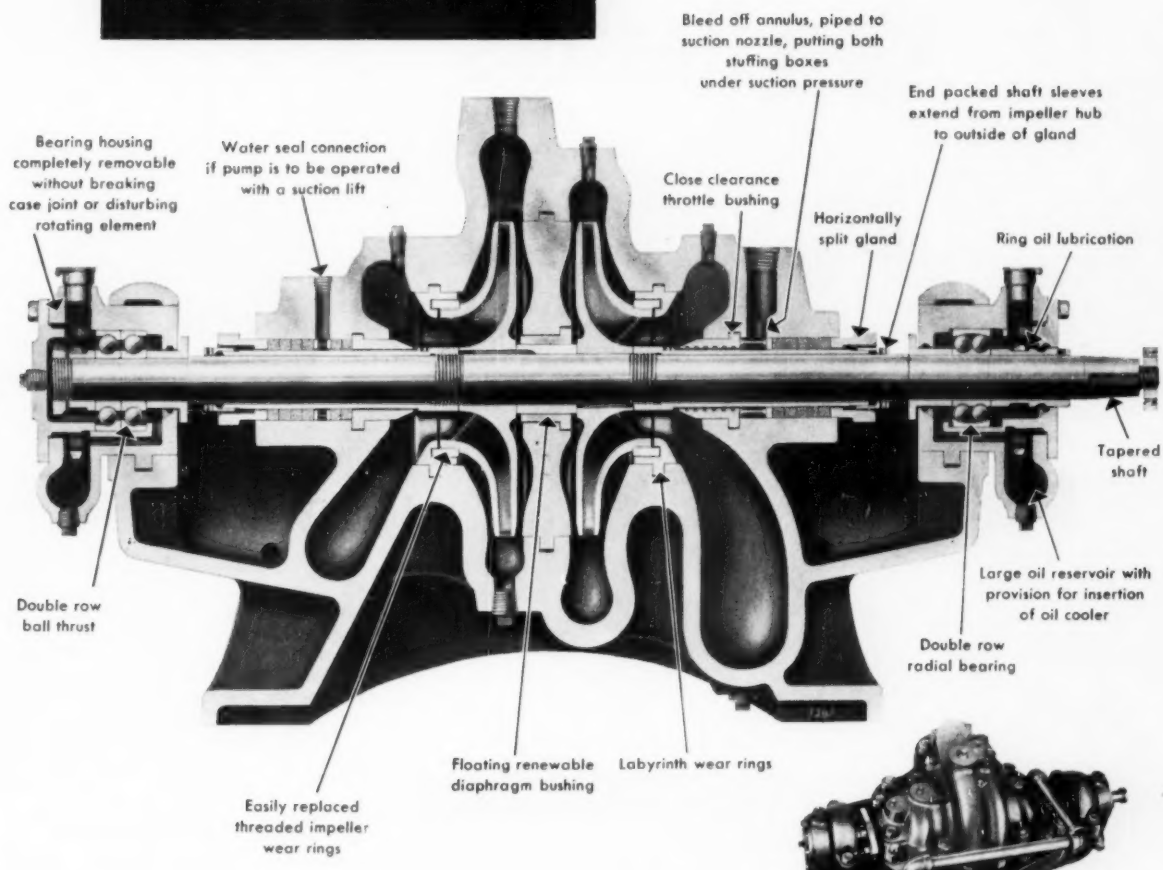
manager, with duties centered mainly in the fields of business and economics, and Leo L. Moran as operating manager in direct charge of all Midland power operations.

Newkirk joined Dow in 1915 as head of a brine pumping station. He then served successively as boiler foreman and superintendent of power before being named Power Department manager in 1940. He became a member of the Midland Division operating board in 1946.

He helped develop the spreader type stoker, holding several basic patents, and contributed to the design of the cyclone-type steam generator, the first of its kind, which Dow put into operation at Midland in 1949. Since then four additional cyclone units have been installed at Midland.

Newkirk also made significant contributions to the design and development of Dow's plant for demineralizing water by means of ion exchange, demineralized water being required at Dow for successful operation of the

DE LAVAL
TWO-STAGE
HORIZONTAL PUMPS


Bleed off annulus, piped to suction nozzle, putting both stuffing boxes under suction pressure
End packed shaft sleeves extend from impeller hub to outside of gland
Bearing housing completely removable without breaking case joint or disturbing rotating element
Water seal connection if pump is to be operated with a suction lift
Close clearance throttle bushing
Horizontally split gland
Ring oil lubrication
Tapered shaft
Double row ball thrust
Large oil reservoir with provision for insertion of oil cooler
Double row radial bearing
Floating renewable diaphragm bushing
Labyrinth wear rings
Easily replaced threaded impeller wear rings

These 14 Design Features Insure Long-range, Low-cost Service

Look at the important design features highlighted in this cross-section. You will clearly see why De Laval 2IS-2KS Two-Stage Horizontal Pumps are designed to give you long, dependable, highly efficient service. • These pumps are precision-made to quality manufacturing standards. They are available in capacities from 75 to 3,000 gpm, sizes from 2" to 8" discharge and heads to 750 feet. Write for Bulletin 1501 giving complete data.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL-225

For more data circle 545 on Post Card

Darts STAND UP for 4 Reasons

Darts deliver longer on the job because of their true ball joint, two bronze seats, practically indestructible bodies and nuts and their extra heavy shoulders. You'll save money in installation time, in labor, in replacement costs and in leakage damage when you insist on Darts!

QUICK FACTS

1. **THE TRUE BALL JOINT** results from spherical grinding. Wide, true-bearing seat surfaces assure quick, easy tightening without jamming
2. **THE TWO BRONZE SEATS** have unusual resistance to pitting and corrosion. You get longer life and leakproof protection
3. **THE BODY AND NUT** of finest grade, air-refined malleable iron are practically indestructible. Stress and stretching are never a problem
4. **THE EXTRA-HEAVY SHOULDERS** are built especially to take wrench abuse

Ask your supplier for Darts — the unions that always stand up — never let you down.

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston•New York•Pittsburgh•Rome, Ga.

DART
UNIONS

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cyclone units. In addition, he was a prime mover in developing the Midland-Saginaw Water Supply System completed in 1948, assuring the two cities and Dow a continuous supply of Lake Huron water. He is vice-president of the Board of Water Commissioners operating the system.

Whiting came to Dow in 1948, serving in the Mechanical Development and Production Economics departments until he joined the Power Department as a results engineer in 1952. He received his B.S. and M.S. degrees in mechanical engineering from Yale University in 1945 and 1948, respectively. Entering the U. S. Naval Reserve in 1944 as an apprentice seaman, Whiting was commissioned an ensign the following year.

Leo L. Moran

Moran has been with the Power Department since 1931. He held positions as an electrician and electrical engineer, was named assistant chief operating engineer early in 1939 and became chief operating engineer late that year. He was promoted to the post of superintendent of power in 1948. He studied electrical engineering at the University of Detroit for four years.

Industrial Water Analysis

SCHEME for the analysis of industrial water was announced to chemists at the semi-annual meeting of the American Chemical Society. It was described by J. H. Phillips, chief chemist and K. G. Stoffer, senior chemist at the Research Center of The Babcock & Wilcox Co.

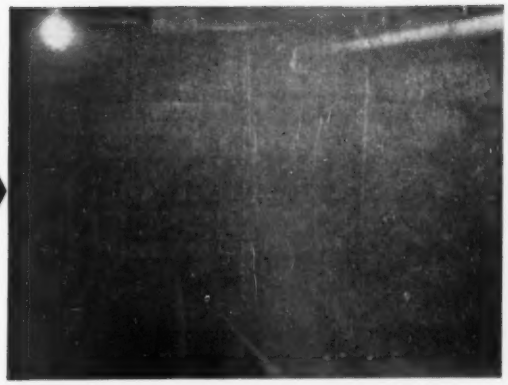
Natural water must be treated with chemicals to remove those undesirable constituents that would interfere with the operation of industrial equipment. It must be treated to remove any constituents that would interfere with the chemical reactions involved in industrial processes. Waste water from many processes must be treated to avoid harmful pollution of streams as governed by city, state, and federal regulations.

The scheme includes a comprehensive list of the properties and constituents in industrial water for which analyses are made and the order of application of the many methods for chemical and physical measurements.

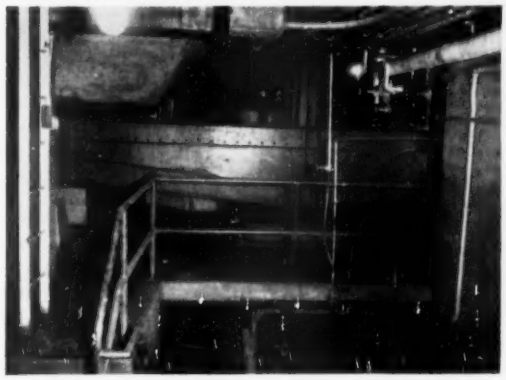
STOP COAL DUST

for 1/10 Usual Cost

at car dumpers, hoppers, crushers, belt galleries, and coal piles



BEFORE — Reciprocating feeder and belt housing in operation at large Illinois utility with Johnson-March System turned off.



AFTER — The same operation taken with the Johnson-March System turned on. Note complete absence of dust. Name of utility will be gladly furnished upon request.

● The Johnson-March Dust Control System *stops dust before it becomes airborne!* And it does it *without expensive ducts, fans and other cumbersome equipment!*

Hundreds of J-M installations daily stop dust efficiently and economically at such sources as car dumpers, hoppers, crushers, belt galleries and coal piles.

Cost of this positive dust control system averages less than 1/10 the cost of other methods. Maintenance costs are next to nothing. Installation is fast, simple and inexpensive. There is no interference with normal plant operations.

Our engineers will be glad to discuss this positive, low-cost system at no obligation. Write today for detailed information.

Johnson March

Specialists in Dust Control

Dept. PE-5 1724 CHESTNUT ST. Philadelphia 3, Pa.

For more data circle 547 on Post Card

For DOUBLE BOILER BLOW-OFF SAFETY

These EVERLASTING Duplex Boiler Blow-Off Units are assuring double safety in plants all over the country.

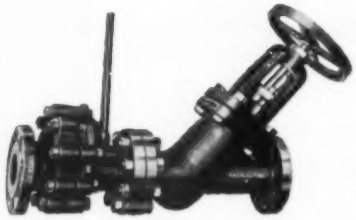
In the unit illustrated above, the left-hand valve is the standard quick-operating EVERLASTING design which opens with a quarter-turn of the lever and closes with a drop-tight seal that actually improves with use. The right-hand valve is an EVERLASTING Angle Valve, stoutly built to withstand shocks and abrasion of blow-down solids.

Below are shown two additional EVERLASTING Duplex Units, each including the EVERLASTING "Y" Valve . . . simple and sturdy in design, with all parts interchangeable with those of the Angle Valve.

All EVERLASTING boiler blow-off designs conform with ASME codes, and are available in a range of sizes for pressures up to 600 psig.

Write for descriptive bulletin.

Two of the many available combinations of EVERLASTING Boiler Blow-Off Units



EVERLASTING VALVE CO., 49 Fisk Street, Jersey City 5, N. J.

Everlasting Valves

TRADE MARK "EVERLASTING" REG. U.S. PAT. OFF.

EV372

FOR EVERLASTING PROTECTION

For more data circle 548 on Post Card

Arc Welding Without a Mask!

THE MAN in the welding mask is on the way out at General Electric's Pittsfield Works. The metal arc welding process, long the most popular method of welding, is meeting competition from a new automatic welding process which throws no sparks, no light, and no metal splatter.

Name of the new process is flexible submerged arc welding. It welds about two to three times as fast as the more conventional method, and it's continuous. Electrode wire is machine-fed into the arc, and the arc is submerged in a granulated flux material that eliminates the painful glare of the conventional arc and allows the operator to weld without a mask.

Nozzle of the machine, in which the arc is submerged, has a pace-setting device that propels the nozzle along the surface at a uniform speed to produce a constant weld size. This pace-setting device is essential to obtain a uniform weld.

The new process has been used for molding tank casings to bases on medium tanks, and on large tanks for welding vacuum braces as well as tank braces. Eight of the machines are already in use in different departments and more are scheduled for use as they become available.

Mainly responsible for developing the pace-setting device was Robert M. Rood, welding engineer, MAP Lab.

According to the *Pittsfield Works News*, the new process won't completely eliminate its predecessor. While the new process is fine on horizontal surfaces, it can't weld on vertical surfaces. And while it is ideal for heavy gage steel, it can't weld sheet metal.

Titanium Facts

THERE is nothing new about titanium except that we now know how to produce it in pure form in large quantities. When the German chemist, M. H. Klaproth, in 1794 gave the name "titanium" to a new metal he was investigating, he likened the strength of the chemical combination of the ore to the great forces symbolized by the mythical Titans.

Titanium was discovered in 1791 by W. Gregor, a clergyman of Menchan parish, Cornwall, England. He concluded from an examination of a black sand found in his parish that the grains were composed of the oxides of iron and a new metal. He called the sand "menachanite" and the new metal "menachite."

Several years later, Klaproth investigated the composition of the mineral, rutile, and named the element that he discovered therein "titanium." It was not until 1797 that Klaproth, while studying the mineral, ilmenite (identical with Gregor's menachanite), recognized that titanium and the element discovered by Gregor were identical. The name "titanium" has continued to be applied and is now accepted.

Titanium Not Rare

Although titanium for years was classified as a rare metal, tremendous quantities of the metal exist in nature. It is the fourth most plentiful of the elements that might be used for construction purposes (after aluminum, iron, and magnesium) and the seventh most common metal. More of it exists than all of the lead, zinc, tin, antimony, nickel, copper, gold and silver combined.

Ilmenite largely is found in hard rock, although some of it is found in sand. By and large rutile is found in beach sand, but there are instances of it being in hard rock deposits.

The largest hard rock ilmenite producing area in the United States is in upper New York State. Other high grade deposits have been discovered in Virginia and North Carolina. Lower grade hard rock deposits are found in California, Wyoming, Oklahoma, Minnesota, Rhode Island, and other states. These deposits vary in size and grade and up to now have not been economical. A concentration of 30 per cent or better in large tonnages is necessary before mining can be profitable.

The greatest hard rock titanium source is located in Eastern Quebec, near Quebec City (the Allard Lake deposit). There is reported to be 300,000,000 tons of ore there and the size may be double or triple that. This ore is smelted to recover a high grade iron. The slag which remains contains about 70 per cent titanium dioxide, and this is sold to be processed into pigment or titanium metal. There are many other deposits where similar ore can be found, but none is known that approaches this in magnitude.

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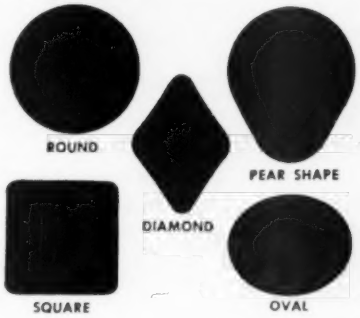
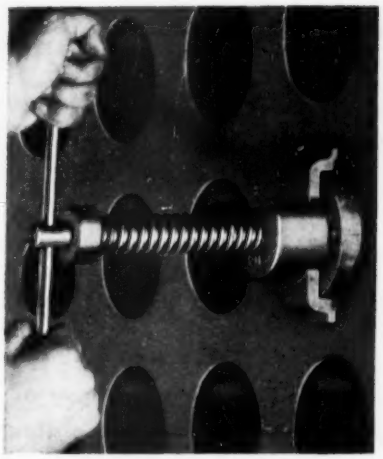
Here is a simple, hand-operated tool for cleaning inside caps on boilers that will pay for itself many times over. This tool is equipped with retractable knives mounted on a revolving spindle having a bearing within a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Try a Roto Seat Scraper and you'll wonder how you ever got along without one.

These are some of the hand hole shapes cleaned with a Roto Seat Scraper. Various sizes available.





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Obituaries

Clark T. Morse

CLARK T. MORSE, prominent Detroit industrialist, died Sept. 18 in London, Ontario, after a brief illness.

Clark T. Morse

Mr. Morse was president of the American Blower Corp. of Dearborn, Michigan, and of the Canadian Sirocco Co., Ltd., of Windsor, Ontario. He was also a director and member of the Executive Committee of the parent firm of those companies, American Radiator and Standard Sanitary Corp.

He devoted his entire business career to American Blower, serving as president for the last 20 years. Born in Evanston, Ill., on Dec. 31, 1888, he obtained a public school education before joining the American Blower Corp. as a sales engineer in 1912.

He served as branch manager for several years, became sales manager of the company in 1923, and was soon elected vice-president in charge of sales. He was elected president in 1933.

Mr. Morse was a life member of the ASH&VE and a member of the ASME. For many years he was a leading figure in the air handling and fluid drive industries.

John O. Larson

JOHN O. LARSON, 39, director and executive vice-president of Fischer & Porter Co., Hatboro, Pa., died Sept. 18. He also served as a director of Fischer & Porter (Canada) Ltd., and of Alloy Steel Casting Co., Willow Grove, Pa., and was widely known as a specialist in industrial application of instrumentation.

Mr. Larson had previously served as the company's sales manager, and as manager of its sales and engineering office in New York.

He was graduated from the Illinois Institute of Technology in 1936 with a degree in civil engineering. He entered the instrumentation field in 1938 with Procter & Gamble Co. in Cincinnati and joined the Foxboro Co. as a sales engineer in 1940.

During the war, Mr. Larson served as an industrial instrument specialist with the War Production Board. He was a member of the Instrument Society of America.

Fred T. Whiting

FRED T. WHITING, 62, vice-president of the Westinghouse Mid-America Region, died Aug. 20 while trout fishing in the Rocky Mountain area of British Columbia. His death was attributed to a heart attack.

Mr. Whiting has been associated with Westinghouse since 1913, when he took his B.S. degree in mechanical engineering at Iowa State College and joined the Westinghouse Machine Co. as a student apprentice in Pittsburgh. Early in 1917, he was transferred to the Chicago office as a sales engineer, but joined the Army when the United States entered World War I. As a first lieutenant, he saw service in the United States and France. He left the service in 1919 with the rank of major.

When Mr. Whiting rejoined Westinghouse as a steam turbine sales engineer, he rapidly advanced to become manager of the Engineering Department one year later. A year after that, he was advanced to manager of the Industrial Department.

From 1930 to date, he has been manager of the important Mid-America Region with headquarters in Chicago.

In 1942, Mr. Whiting was awarded the Westinghouse Order of Merit for "outstanding leadership." A year later he was elected vice-president of Westinghouse.

In 1946, Mr. Whiting received the Iowa State Marston Medal, and in 1953 received an honorary Doctor of Engineering degree from Iowa State University.

Arthur M. Greene, Jr.

ARTHUR M. GREENE, JR., Dean Emeritus of Princeton University's School of Engineering and one of the country's best known figures in the field of mechanical engineering, died from a heart attack Sept. 2 while swimming at Madison, Conn.

Dean Greene, 81, was called to Princeton in 1922 from Rensselaer Polytechnic Institute to organize the School of Engineering as an educational unit. A year ago, Dean Greene achieved a lifelong ambition by teaching past his 80th birthday. Since entering the ranks of professors emeriti,

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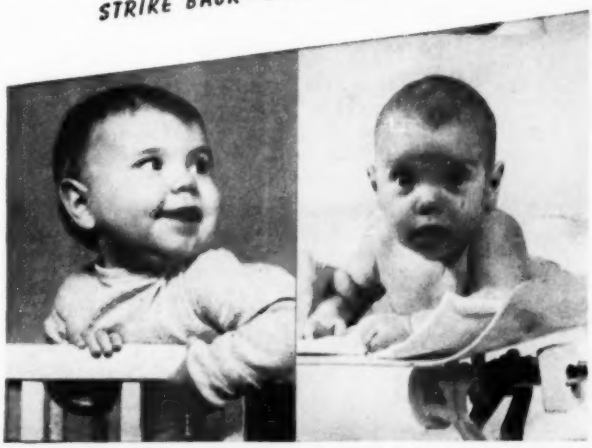

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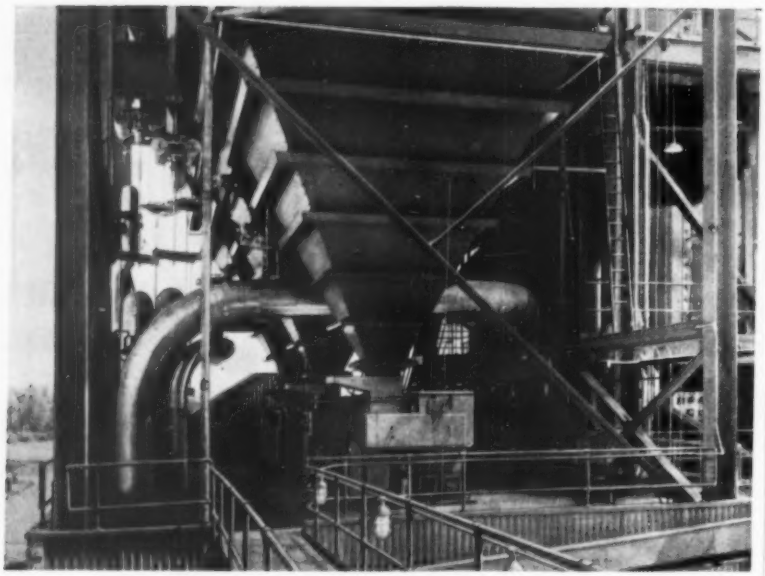

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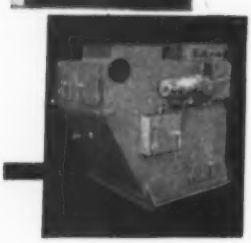

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he had continued to teach a graduate course in engineering economics.

Dean Greene took his B.S. degree at the University of Pennsylvania in 1893, and his M.E. degree at the same institution the following year. In 1917 he received an honorary doctorate of science from Pennsylvania and was awarded an honorary Doctor of Engineering by Rensselaer in 1922. The honorary degree of Doctor of Laws was conferred on him by the University of Missouri in 1940.

An honorary member and past vice-president of the ASME, he was also past president of both the Society for the Promotion of Engineering Education and the Society of Engineers of Eastern New York. He was a Fellow of the American Association for the Advancement of Science as well as a member of the Franklin Institute of Philadelphia, the Newcomen Society of Great Britain, the Engineering Foundation, and the American Engineering Council.

Dean Greene was a member of Phi Beta Kappa, Sigma Xi, and several honorary engineering fraternities. He was a prolific writer on technical subjects and was the author of a number of standard works including Elements of Heating and Ventilation, Elements of Refrigeration, Elements of Power Generation, and Elements of Hydraulic Power Generation.

New ENGINEERING BOOKS

Gas Turbine Analysis and Practice, by Burgess H. Jennings, professor and chairman, department of mechanical engineering, and Willard L. Rogers, assistant professor of mechanical engineering, The Technological Institute, Northwestern University, 475 pages; illustrated; size 4½ in. by 7 in.; cloth binding; published by McGraw-Hill Book Co., Inc., New York, N. Y. 1953. Price $8.50.

This is a good text book. It covers the subject completely and deals with each part thoroughly. The illustrations are good and there are plenty of them. The book is for readers with a knowledge of thermodynamics and mechanics. In addition to its value as a text book for students, it gives practicing engineers a good idea of the gas turbine field as it stood at the beginning of 1953. So much of the book deals with fundamentals that it should not become outdated for some time, despite the present rapid advances in gas turbine development.

A very comprehensive bibliography is given at the end of each chapter, also a number of problems to illustrate the subjects discussed in the chapter. Many of the problems, however, are of little value as they have no answers, and those with answers

would be better if the answers were listed in some part of the book away from the questions. These, however, are small points, and detract very little from the book's value. Here is an outline of the subjects covered:

First comes a brief description of the development of the gas turbine, followed by a chapter on thermodynamics and air properties, including a very useful set of tables giving the thermodynamic properties of air at low pressures for temperatures ranging from —59.7F to 1980.3F. Various gas turbine cycles are discussed and analyzed, with diagrams of the open and closed cycles systems.

Gas turbine types and design features, nozzles, blading and blade speeds are analyzed, and modern blade construction is well illustrated with photographs of rotors and stators made by several manufacturers. Then follows a fairly exhaustive treatment of compressors, starting with axial flow units, giving formulas, diagrams and charts to explain blading design and problems. The same treatment is given centrifugal and displacement compressors.

In a chapter on the application of the gas turbine to aircraft propulsion, various types of jet engines are described with interesting comparisons between piston engines, turbine propellor machines and straight jet propelled jobs. The gas turbine for industry, railroads, other forms of transportation, and pumps is discussed, with descriptions of the various experimental and operational units that already have been in service for some time. The operating data and performance charts are particularly good throughout the book. Fuels, combustion, and combustion chambers are analyzed and illustrated by the latest practice in combustor manufacture.

The book concludes with chapters on stress in turbine-plant elements, vibration, balancing, and the application of metals and metallurgy to the gas turbine.

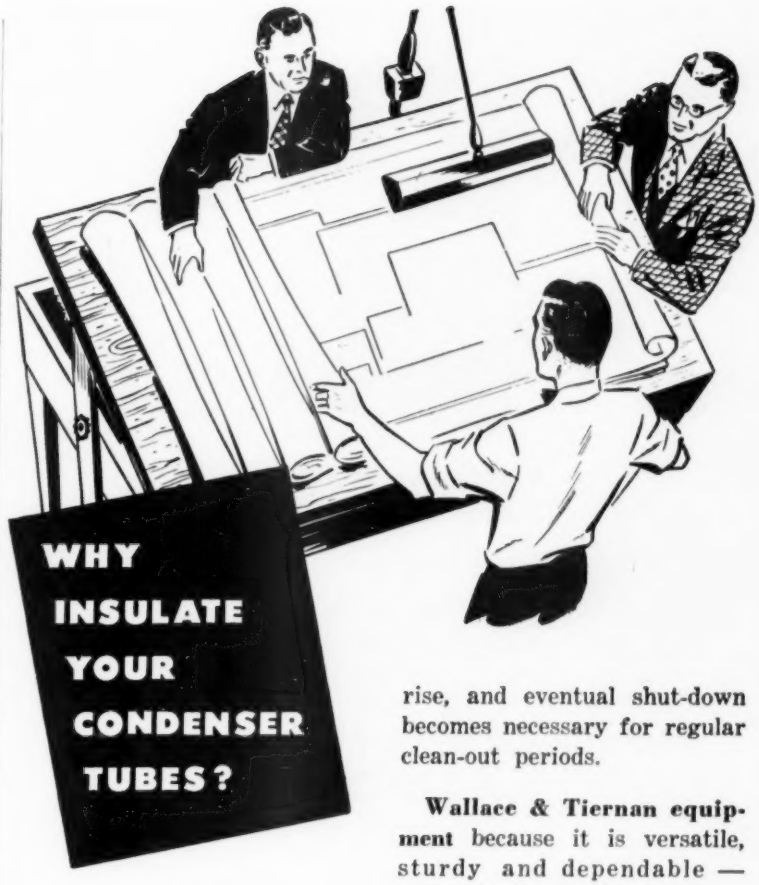
★ ★ ★

1952 Book of ASTM Standards, Including Tentatives, Parts 1, 2, 3 and 5; 1200 to 1500 pages each; illustrated; size 6 by 9 in.; cloth binding. Published by American Society for Testing Materials, 1916 Race St., Philadelphia, Penna. Price: Parts 1, 2, and 3—$12.00 each; Part 5 — $10.00.

These are only part of the complete book of ASTM Standards for 1952 that has just been issued. The set consists of seven volumes but it seemed to us that those noted above will be of most use to the power engineer, whereas some of the others deal with industrial products he does not have to handle.

Part 1 is the most widely distributed part of the Standards. It covers all types of steel, both carbon and alloy, also metallic coatings, wrought iron, cast iron, malleable iron, etc. It also gives specifications for testing methods, such as metallography, tension, compression, hardness, magnetic particle testing, and all other tests applicable to steel.

Part 2 deals with non-ferrous metals. It



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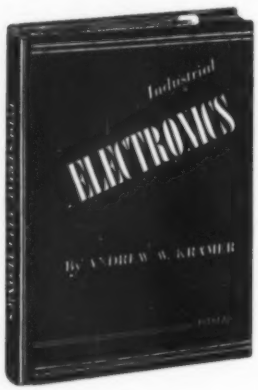

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For any engineer or organization which has to purchase equipment and materials, it seems to us these books of standards are indispensable.

* * *

Code for Pressure Piping — ASA B31.1a–1953; Supplement No. 1 to ASA B31.1–1951; 24 pages; illustrated; size 8½ by 11 in.; paper binding. Published by the American Society of Mechanical Engineers (B. M. Shackelford, Standard Administrator) 29 West 39th Street, New York 18, N. Y. Price $1.00, discount to members and for quantities.

Following the publication of the 1951 edition of the Code for Pressure Piping, which was the latest complete edition, the committee that had been working jointly with the ASME Boiler Code Committee and the ASA Sectional Committee, Committees B16 and B36, recommended a revised basis for establishing allowable stresses for certain materials common to the several codes in the standard. In order to put these revisions into the hands of the users of the code, the committee voted to approve publication of this 1953 Supplement.

It begins with a discussion of changes in specific paragraphs of the 1951 code, such as paragraph 122 (a, b, c, d, e, and f); instructions to remove table 4; revision of formula 9, and so on. It then presents the latest revised tables of allowable S values for pipe in power piping systems, oil piping systems, and district heating piping systems.

All engineers who have the 1951 Code for use in their work should obtain this supplement giving the latest data.

* * *

Atmospheric Pollution. By A. R. Meetham, D.Sc. 264 pages, 4 by 6¼ in., cloth. Published by Pergamon Press Ltd., 2, 3 and 5 Studio Place, Kinnerton Street, London, S.W. 1. England. 1952. Price $4.90.

D.. Meetham has packed a remarkable amount of information into his survey of atmospheric pollution, from the execution of the unfortunate artificer who violated a smoke abatement law in 1306 to the preventive measures we are taking in our less barbarous but smokier times. Though the atmosphere can be polluted in many ways, fuel is by far the worst offender, so most of the book is devoted to atmospheric pollution caused by the combustion of coal, oil, and other fuels.

This is a good book for those wanting a general picture of the whole field of atmospheric pollution. It is easy to read, technical jargon has been avoided, and though such a wide survey prevents more than brief reference to each item, they are described thoroughly enough to provide at least a foundation for more technical studies.

The author describes the origin and characteristics of various natural and artificial fuels; construction and operation of such major polluters as boilers, furnaces, kilns, etc.; how atmospheric pollution is measured; its effects, distribution, cycles, and ways it can be limited or prevented. He concludes with a description of the anti-smoke laws in Britain and the United States.

For the American reader the book has the disadvantage of referring to British rather than U. S. practice; but as the pollution problems of both countries are practically identical, this detracts very little from its value.

P. G. and E. of California, by Charles M. Coleman; first edition; illustrated; 392 pages; size 6 by 9 in.; cloth binding; published by McGraw-Hill Book Co., Inc., 330 West 42nd St, New York 36, N. Y.; price $4.50.

Starting in colorful Gold Rush times, this story of a famous company spreads a panorama of individualistic men, rugged enterprise, and American history. The exciting, picturesque era spanned by Pacific Gas & Electric's first century is vividly recorded in terms of the men and forces that shaped its development. The rich flavor of California and Western history of that period permeates and forms a backdrop for the story.

Instead of a detailed chronology of the more than 500 utilities that are fused in the present organization, this story focuses on the men and the leaders of men who lived this saga with enterprise, courage and vision.

Then, as the population and industries of California grew, power went farther and farther afield. New hydroelectric plants, natural gas from Texas, the depression, the fight against government control . . . all contributed their part to the P. G. and E. story.

Painstaking research and a feeling for the spirit of the Golden State combine to make this a good deal more than a matter-of-fact company history. This is the sort of industrial history that is not only valuable but also good reading.

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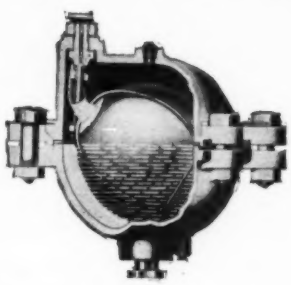

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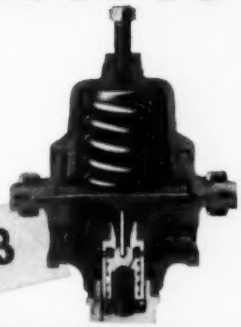

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The Science of Flames and Furnaces by M. W. Thring. Size 5½ by 9 in.; 416 pp, including index; illustrated; cloth bound. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $6.50.

What goes on inside a furnace? Because all metals, glass, ceramics, cement, and even building brick are either melted or undergo some physical or chemical change of high temperatures, it is well to know what goes on inside a furnace. The answer to this and many other questions will be found in this book on furnaces.

The book is broken down into seven sections, covering: the function of a furnace; the thermodynamics of furnace heating; the liberation of heat by combustion; heat transfer; the aerodynamics of hot systems; the science of furnace construction; and the application of the scientific method of furnaces. It might be well to note that the book deals mainly with furnaces heated by flame and omits any discussion of electrical furnaces.

★ ★ ★

Research Bulletin 18, Thermodynamic Properties of Nitrogen, by O. T. Bloomer and K. N. Rao; 30 pages; illustrated; size 8½ by 11 in. Paper binding. Published by the Institute of Gas Technology, 17 W. 34th St., Technology Center, Chicago 16, Ill. Price $3.50.

Nitrogen is chemically inert and is a non-combustible diluent that lowers the heating value of natural gas in direct proportion to its concentration; hence engineering design of plants to separate nitrogen from natural gas requires accurate data on the thermodynamic properties of nitrogen over a wide range of conditions. To provide such data, research workers at the Institute of Gas Technology have provided charts and discussion in this booklet on the basis of recent fundamental data.

The properties are presented in tabular form and also as charts of enthalpy versus entropy and of compressability factor as a function of temperature and pressure. Range of tables and charts is from saturated liquid at minus 320.4F to superheated vapor at 500 F and pressures from 10 to 1500 psia. As a supplement to the bulletin, the mollier chart for nitrogen and compressability chart for nitrogen have been reproduced full scale on heavy paper 22 in. by 34 in.

★ ★ ★

Engineering Drawing, by Josef V. Lombardo, Albert J. Lombardo, Lewis O. Johnson, and W. Irwin Short; 432 pages; illustrated; size 5¼ by 8¼, paper bound. Published by Barnes & Noble, Inc., 105 Fifth Ave., New York 3, N. Y. Price $2.00.

This comprehensive guide for the engineering student has been prepared by four university professors, one of whom is now on the engineering staff of Otis Elevator Co.

Joseph V. Lombardo is assistant professor, Queens College; Lewis O. Johnson, associate professor of engineering drawing, New York University; W. Irwin Short, professor Civil Engineering, University of Pittsburgh, and Director of undergraduate work in industry in the schools of engineering and mines there; and Albert J. Lombardo, formerly an instructor in fine arts and engineering drawing at Hofstra College.

Included are the basic principles and rules of engineering drawing, with problems, tables, ASA standard drawings and drafting room practice. Keyed to standard textbooks, the book is part of the college outline series.

The authors believe that since drawing may be broken down into principal parts, the task of learning may be accomplished in the same way. In the first three chapters, which deal with control of appearance (linework and use of instruments, geometric construction and lettering), the procedures are somewhat mechanical and may be mastered easily by the average student.

Chapters four through seven deal with visualization of size and shape of objects, which, the authors feel, is as vital an aspect in engineering drawing as in all works of engineers and in all branches of engineering.

Mastery of the subject matter in these chapters is therefore an essential preparation for the working procedures outlined in the final chapters of the text. These include dimensioning, standard fasteners, sizes and means of fastening. The working drawing, as described in Chapter 10, requires consolidation of all previous information in the text.

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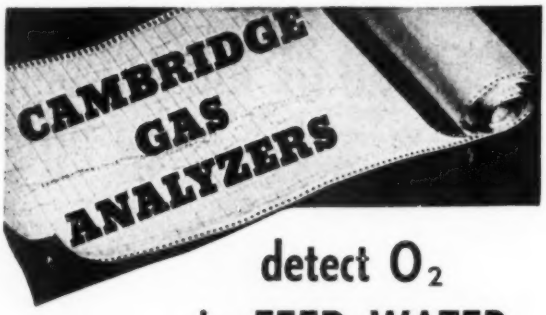

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HELPFUL BULLETINS

(*Continued from page 36*)

130 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semisteel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

131 Pipe Repair Clamp — Folder 201, 6 pp, gives details of a method by which pipe line leaks of any kind can be permanently and quickly repaired. Illustrates installation for both single and double repair clamps, and gives prices. Morris Coupling and Clamp Co.

132 High-Pressure Fittings — Catalog 553, 28 pp, covers a line of high-pressure tube and pipe fittings. Describes and illustrates company's Prize Pair flare and no-flare type tube fittings designed to seal pressures that will burst the tube. Engineering tables are supplemented with complete specifications on all fittings, and catalog contains helpful tips on selection of proper tubing. Flodar Corp.

FEEDING, PROPORTIONING

133 Selection of Chlorine Gas Feeders — Technical Information Sheet 840-J37 gives factors of importance in choosing chlorine gas feeders for sewage chlorination. Prepared as a guide for engineers interested in the application of chlorine for sewage treatment, this sheet discusses purposes of sewage chlorination, types of chlorination, points of application, etc. Builders Providence, Inc.

134 Proportioning System — Bulletin 0351, a 6-pp bulletin, pictures and describes company's recently developed proportioning and materials handling system for making up formulated mixes of bulk products. The operation of the electronic control system, rates, accuracies and possibilities of remote recording are explained, also formulating, feeding, weighing, mixing. Richardson Scale Co.

OTHER EQUIPMENT

135 Engine Application — Form 30743 titled, "More Power at Less Cost," is an 8-pp booklet covering six sizes of engines and containing photos illustrating applications of industrial engines, diesel electric sets and others. Explains how company designs these units to suit specific needs of users. Caterpillar Tractor Co.

136 Engineering Services — What this company offers in engineering and other professional services is presented in a 40-pp brochure. Covers engineering and design, construction supervision, industrial engineering, sanitary engineering, chemical laboratory services, safety engineering and others. Includes separate project booklet. Gilbert Associates, Inc.

137 Blowers and Exhausters — Bulletin B-6, 32 pp, covers centrifugal blowers and exhausters for air or gas handling. Typical applications are illustrated and described. Performance data is presented for air blowers and exhausters with cast iron housing ranging from 1 to 7 psi; for air blowers and exhausters with fabricated steel housings, ¼ to 3 psi; and gas blowers with cast-iron housings. Lamson Corp.

138 Multi-Stage Centrifugal Pumps — Eighteen-pp Form 7251 presents company's Class CNTA multi-stage centrifugal pumps designed for boiler feed, refinery, process work and other pumping services and available for pressures from 300 to 1000 psi with capacities to 700 gpm. Ingersoll-Rand Co.

141 Hydraulic Hose Selector — The Wiretex rubber covered hydraulic hose selector is offered to users of hydraulic control hose. Starting with any known factor — the ID, OD, minimum burst working pressure required etc. — you can find the hose for the job. Republic Rubber Div., Lee Rubber & Tire Corp.

. . . Outstanding Among This Month's Catalogs . . .

139 Steam Trap Service Guide — Bulletin 239, 8 pp, takes much of the guess-work out of trapping. It was prepared for users of company's steam traps. It tells how to install and test them; and gives inspection, preventive maintenance procedures, hints on trouble shooting and repair. Besides regular repair parts lists, new tables give parts identification by dimension, parts interchangeability and pressure change assembly interchangeability. Includes diagrams of recommended hook-ups. Armstrong Machine Works.

140 High-Voltage Power Cable — A technical data book on rubber insulated power cable for use up to 35,000 v, 128-pp Bulletin OK-1075 covers its advantages, economies and versatility. Filled with practical information, this book provides current carrying capacity tables, aluminum conductor conversion factors, formulas on effects of shielding, dimensions on bare conductors, installation recommendations, other data. Of special interest are detailed drawings and instructions for splicing. The Okonite Co.

142 Care, Installation of Packings — In addition to information concerning what packings should be used on various installations, this 112-pp catalog (Form M-3105) contains metric engineering tables and conversion charts for both centigrade and Fahrenheit temperatures. Helpful tips on maintenance for rod and plunger packings and gaskets are provided. Also included is a chart on chemical resistance of gasket materials, as well as tables on melting points and specific gravities. Available to qualified power engineers. United States Rubber Co.

143 Pressure Relief Valve Selection — "Selection and Sizing Pressure Relief Valves to Comply with ASME Boiler Code Requirements," 24 pp, provides easy-to-use data for determining the output of all types of boilers, tanks and heaters. Formulas and tables cover recommended relief valves for cast-iron and steel boilers, as well as those for which there is no nameplate data or set procedures for establishing output. Also covers other equipment. McDonnell & Miller, Inc.

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FUEL OILS, LUBRICANTS

201 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

202 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

203 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

204 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

205 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

BOILERS, GENERATORS

206 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

207 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions and weights given. The Babcock & Wilcox Co.

208 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

209 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of company's boilers. Cleaver-Brooks Co.

210 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

COAL, ASH HANDLING

211 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

212 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

213 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

214 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

215 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is

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November 1953
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POWER ENGINEERING

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1	2	3
4	5	6
7	8	9
10	11	12
13	14	15
16	17	18
19	20	21
22	23	24
25	26	27

Helpful Bulletins

101	102	103	104	105	106
107	108	109	110	111	112
113	114	115	116	117	118
119	120	121	122	123	124
125	126	127	128	129	130
131	132	133	134	135	136
137	138	139	140	141	142
143	144	145	146	147	148
149	150	151	152	153	154

Catalog Library

201	202	203	204	205	206	207	208	209	210	211	212
213	214	215	216	217	218	219	220	221	222	223	224
225	226	227	228	229	230	231	232	233	234	235	236
237	238	239	240	241	242	243	244	245	246	247	248
249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272
273	274	275	276	277	278	279	280	281	282	283	284
285	286	287	288	289	290	291	292	293	294	295	296
297	298	299	300	301	302	303	304	305	306	307	308

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522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542
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564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584
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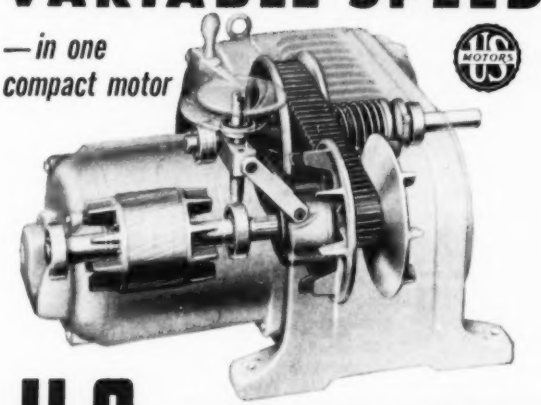

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On page 144 of the Sept. 1952 issue of MARINE ENGINEERING & SHIPPING REVIEW you will find that ATLAS is credited with furnishing: "Valves, regulators and strainers (composition reducing valves, composition pressure reducing valves, combined pressure and temperature regulators, composition strainers)" — all on the S.S. United States.

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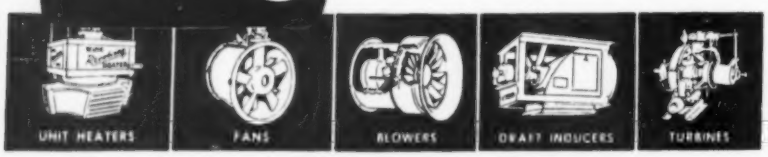

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fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

216 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B; which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

VALVES, TRAPS, PIPING AND ACCESSORIES

217 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

218 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

219 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

220 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

221 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

222 Cast Steel Valves — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

224 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

225 Regulating Valves — Bulletin 313 describes double seated diaphragm regulating valves for use with control

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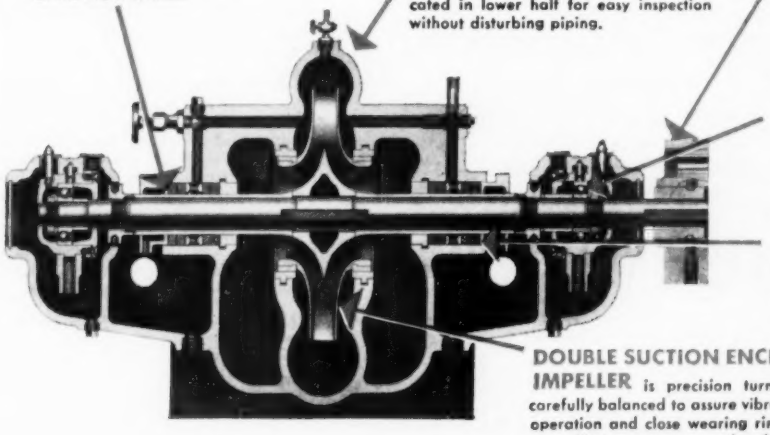

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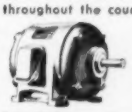

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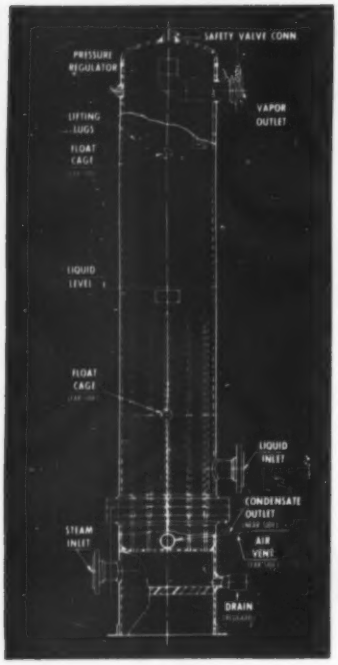

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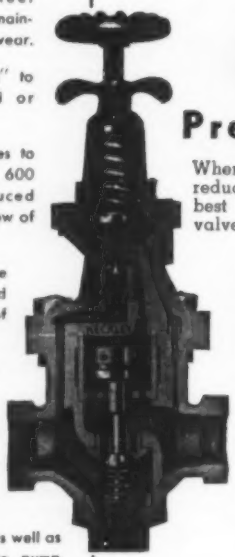

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instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

226 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages of the valves are discussed. R. S. Products Corp.

227 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

228 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

229 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

Postage-free cards for ordering these catalogs are on pages 35 and 118. When using them, don't forget to include your job title and company name—even if you want those catalogs to be delivered to your home address

230 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp., provides capacity tables, installation, diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline, also piston-operated traps. W. H. Nicholson & Co.

231 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

232 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel

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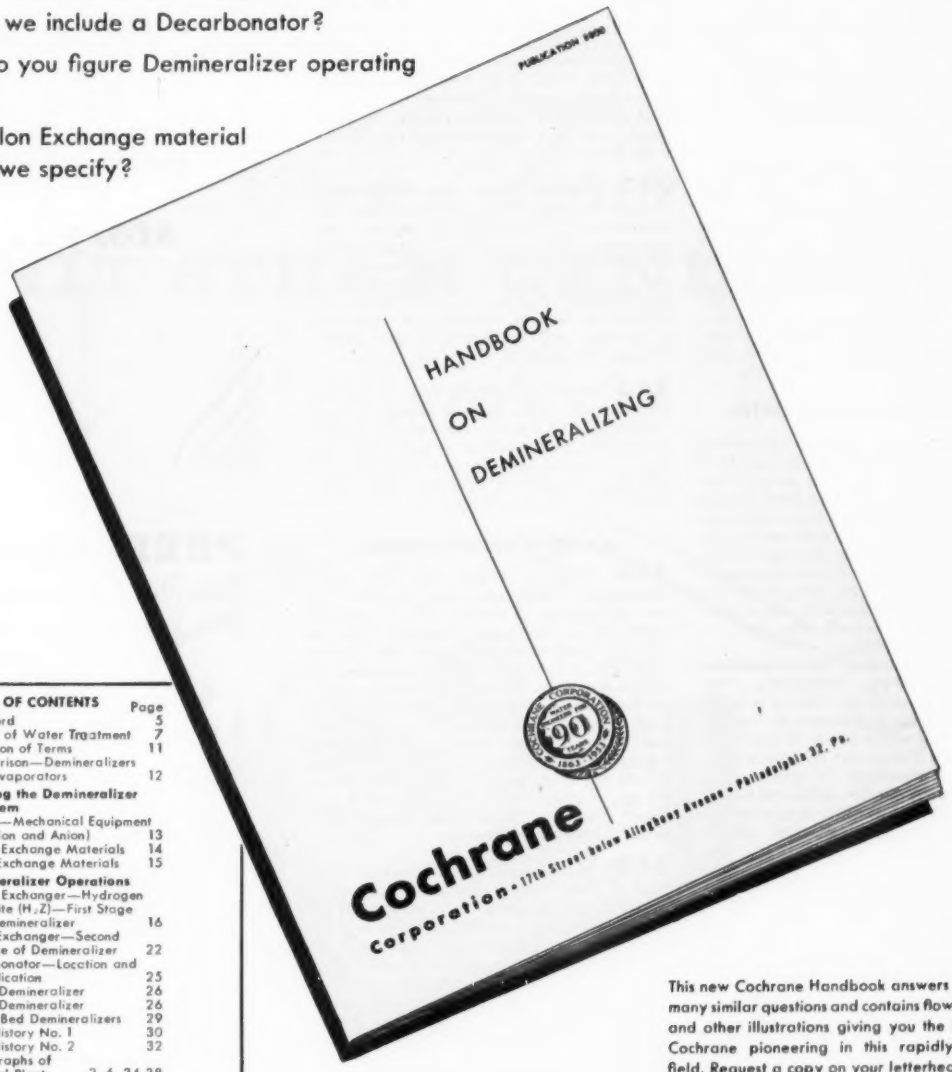

TABLE OF CONTENTS

	Page
Foreword	5
History of Water Treatment	7
Definition of Terms	11
Comparison—Demineralizers vs. Evaporators	12
Building the Demineralizer System	
Details—Mechanical Equipment (Cation and Anion)	13
Cation Exchange Materials	14
Anion Exchange Materials	15
Demineralizer Operations	
Cation Exchanger—Hydrogen Zeolite (H_2Z)—First Stage of Demineralizer	16
Anion Exchanger—Second Stage of Demineralizer	22
Decarbonator—Location and Application	25
3-Bed Demineralizer	26
4-Bed Demineralizer	26
Mixed Bed Demineralizers	29
Case History No. 1	30
Case History No. 2	32
Photographs of Actual Plants	2, 6, 34-38

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welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

233 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

234 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for selecting proper hangers, tables of dimensions, plus erection are given. National Valve & Mfg. Co.

TUBING AND ACCESSORIES

235 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifications, conversion tables, and weights. Scovill Mfg. Co.

236 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

237 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

238 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

239 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

240 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

HEAT EXCHANGING, COOLING

241 Heat Exchangers — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

242 Finned Tube Heat Exchanger — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

243 Heat Exchanger — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

WATER CONDITIONING

244 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques dicussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

245 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

246 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

247 Data on Zeolite Softeners — Publication 4520-A is a 32-pp well illustrated booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of Zeolite materials and discussion of the operating stages of a sodium zeolite softener. Cochrane Corp.

248 Mixed-Bed Demineralization — Bulletin 126 explains in text and pic-

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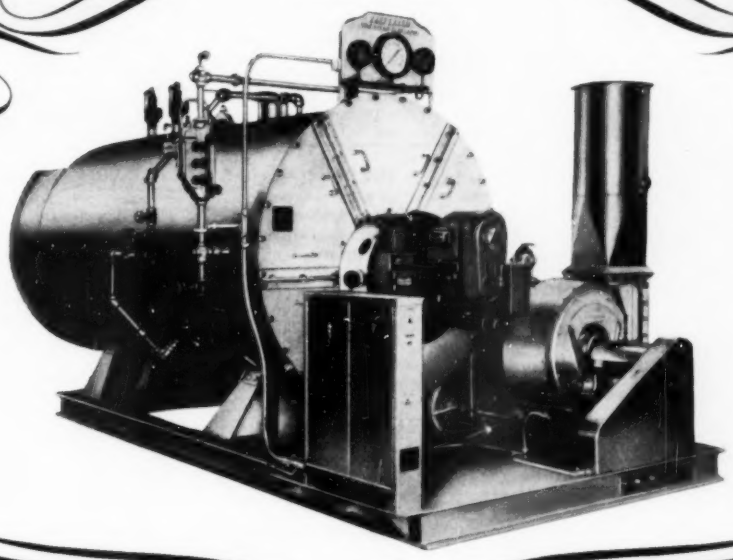

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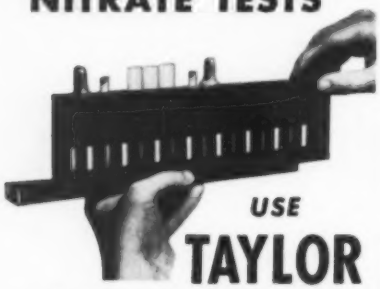

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tures how a mixed-bed demineralizer operates in producing high-purity water by ion-exchange method. Stresses company's simplified positive regeneration system which separates resins quickly and remixes them. Barnstead Still & Sterilizer Co.

249 Treatment by Ion Exchange — Methods of ion exchange treatment and its general and special applications for water and other liquids are explained in 8-pp Bulletin A. Discusses manufacturers' deionizing equipment as to construction and operation, pictures applications. Illinois Water Treatment Co.

Postage-free cards for ordering catalogs and bulletins are provided on pages 35 and 118

251 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

252 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

253 Feedwater Heating System — This bulletin describes a flash-type deaerating feedwater heating system offering flexibility in the use of steam at different levels. The Whitlock Mfg. Co.

255 Deaerating Heaters — Bulletin WC-101A, 8 pp, covers spray-type deaerating heaters, stressing their importance as boiler safeguards. Explains operation of these heaters to show how they provide effective deaeration. Illustrated by photos and drawings of both vertical and horizontal models, text discusses first- and second-stage heater sections, performance results, and applications. Equipment utilized in the spray-type heaters is described briefly. Graver Water Conditioning Co.

PACKINGS, GASKETS, SEALS

257 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

258 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

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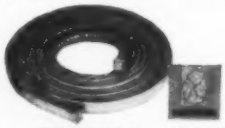

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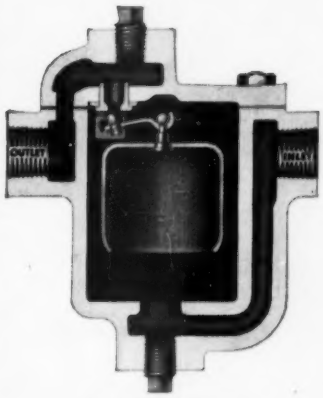

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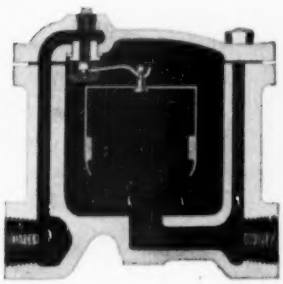

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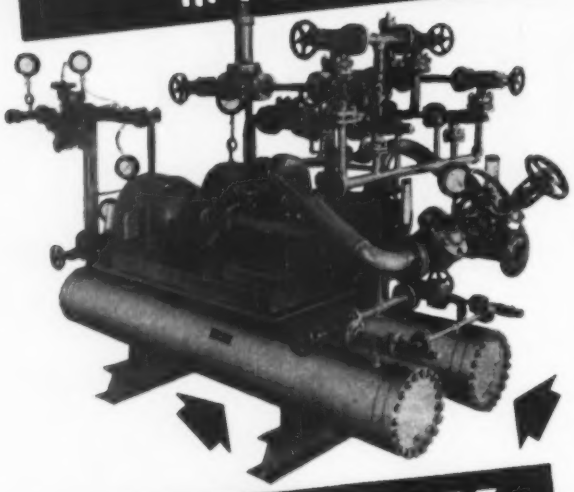

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260 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

262 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls. Republic Flow Meters Co.

263 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

265 Central Control Panels — The use of this manufacturer's Panelgraphs in a broad range of industrial control applications is shown in Bulletin PI-153. These panels utilize visual aid techniques to present process information, enabling the operator to comprehend large masses of data and keep process functioning properly. Shows installations in power stations refineries. Panellit, Inc.

266 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

267 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information and company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

269 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

270 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydro-

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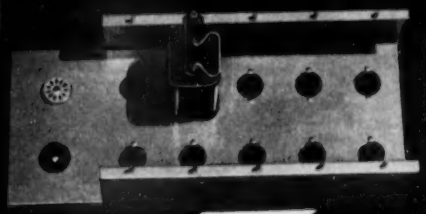

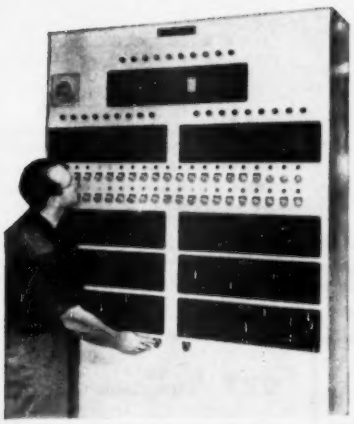

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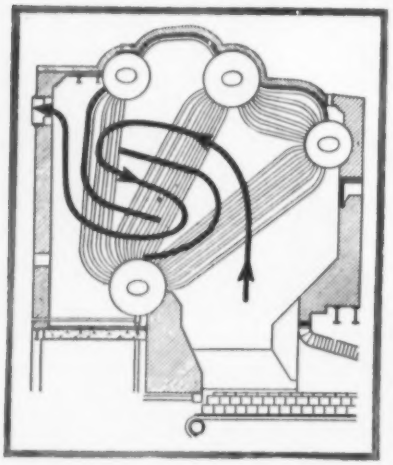

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gen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

271 Pneumatic Valve Operator — This 8-pp bulletin explains operating principles and outstanding features of the Rotomotor positioning operator for throttling control service. Tells how this heavy duty, all-pneumatic operator is designed to combine safety and economy of air operation with the power of a gear driven screw stem. Conoflow Corp.

272 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

273 Boiler Control — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

275 Pressure Regulator — Bulletin 1-B, 8-pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for back pressure relief valve. Atlas Valve Co.

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276 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

277 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. United States Rubber Co.

278 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

279 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief out-

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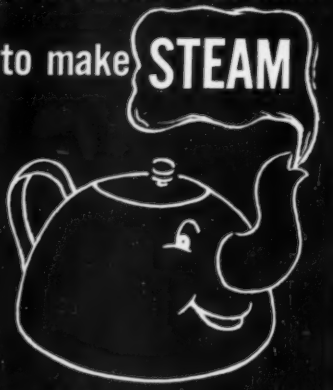

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line of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

280 Totally-Enclosed Motors — Eight-pp Form 1784, illustrated in full color, presents a line of totally enclosed motors, including types for both hazardous and non-hazardous locations. Design details of the motors are shown in a large cutaway drawing, and special construction features are pictured. Includes application information. U. S. Electrical Motors, Inc.

OTHER EQUIPMENT

281 New Engine Developments — Bulletin S-500-B-55, 12 pp, presents new developments in oil diesel, dual fuel diesel and high compression spark ignition engines. Describes features of modern, economical, heavy duty, internal combustion engines. Includes a heat balance chart showing waste heat recoverable from exhaust gases and jacket cooling water; and is accompanied by fuel cost charts and descriptions of installations utilizing heat recovery systems. Engine Div., Worthington Corp.

282 Refractory Cements — Sixteen-pp Form 863, presenting a line of refractory cements, discusses the three basic materials used in them, provides a detailed selection guide and illustrated discussion on methods of preparation and installation. Also defines terminology. Norton Co.

283 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

284 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

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286 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. L. J. Wing Mfg. Co.

287 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

288 Complete Combustion System — This bulletin describes seven complete combustion systems in metropolitan New York. Includes "before and after" pictures of installations at Astor Hotel, West Point Military Academy, Gimbel Bros. Peabody Engineering Corp.

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290 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

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With the introduction of an exclusive new oil-eliminating feature, Nicholson air traps now enable you to enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Other features of Nicholson air traps:

1) No air-wasting vent, such as is in all inverted bucket traps.
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Three types; pressures to 1500 lbs. These weight-operated traps also for steam.

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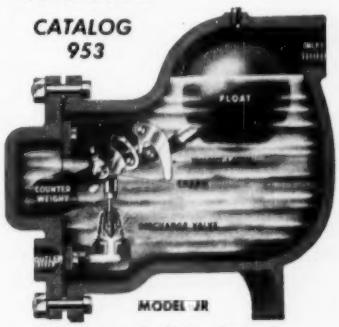

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14 TONS AT A TIME

70 tons of coal stockpiled in 5 passes by Allis-Chalmers HD-20 Tractor with Special Coal Blade

COAL is brought to the power plant of a large northern Indiana industrial plant by rail. Cars are dumped over hoppers and coal not needed immediately at the plant is stockpiled.

As this coal flows from the stacker it is dozed out over the stockpile by an Allis-Chalmers HD-20 Tractor equipped with specially designed Baker coal blade. The coal from 70-ton cars is moved 150 to 200 ft. in five passes, coal from two 50-ton cars takes seven passes — an average of 14 tons at a pass.

Tractor Compacts Coal

The coal is well compacted to help prevent spontaneous combustion, through the repeated trips of the heavy tractor over the stockpile. Complete with blade, the unit weighs approximately 25 tons — enough to tightly pack the horizontal layers of coal and eliminate the flues that often lead to burning.

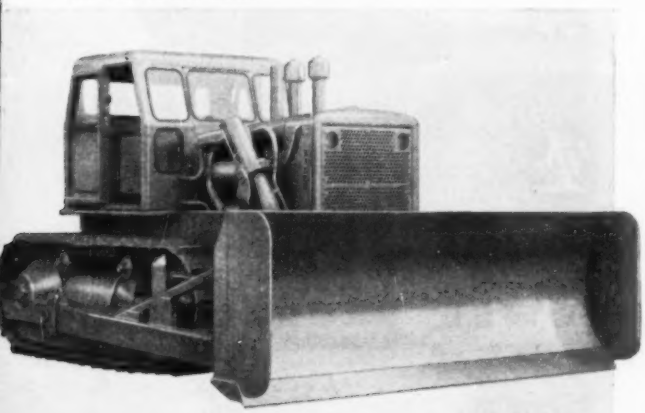
With a 175-hp. diesel engine, the tractor has plenty of power for moving big loads. A hydraulic torque converter drive multiplies torque up to four and a half times where needed to start the load of coal, then automatically accelerates to the highest traveling speed that conditions permit.

Has Hydraulic Steering

Convenience of operating and servicing the HD-20 Tractor also contributes to its high over-all output. Hydraulic control permits steering with the touch of a finger. Other operator conveniences include comfortable seats, clean platform and excellent visibility. For simplified repair, major tractor assemblies are easily removed without disturbing adjacent parts. Truck wheels, idlers and support rollers need be lubricated but once in 1,000 hr. There are no lubrication fittings under tractor.

Additional information about this HD-20 Tractor and coal blade — or about the three other Allis-Chalmers tractors, tractor shovels, scrapers and motor scrapers for stockpiling coal — can be obtained from an Allis-Chalmers dealer or direct from the company.

Big Allis-Chalmers HD-20 Tractor has 175-hp. diesel, weighs 25 tons complete with blade. Baker coal blade has extra, 56-in. height and 14-ft. length, plus boxed-in ends that help carry 15 to 20 percent larger load than regular blade.



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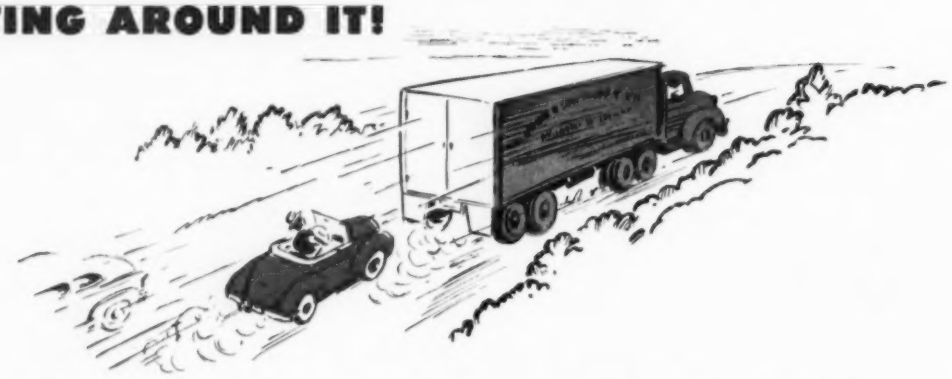
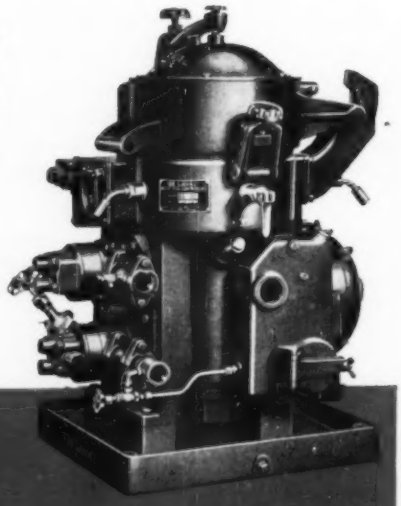


De Laval Turbine Oil Purifiers Prevent Contamination Trouble by Removing the Causes

De Laval Centrifugal Oil Purifiers remove both of the chief causes of lubricating oil deterioration—dirt and water. They are positive insurance that no trouble will occur that can be charged to impure oil.

A De Laval Oil Purifier does a thorough job. Every drop of water is promptly thrown out by centrifugal force and continuously discharged to waste. Dirt is likewise thrown out of the oil and stored outside of the zone where purification takes place.

An important advantage of the De Laval Oil Purifier is the fact that it has enough reserve capacity to take care of a sudden emergency such as a surge of water due to a leak.



THE DE LAVAL SEPARATOR COMPANY
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DE LAVAL

FOR MORE DEPENDABLE POWER PRODUCTION

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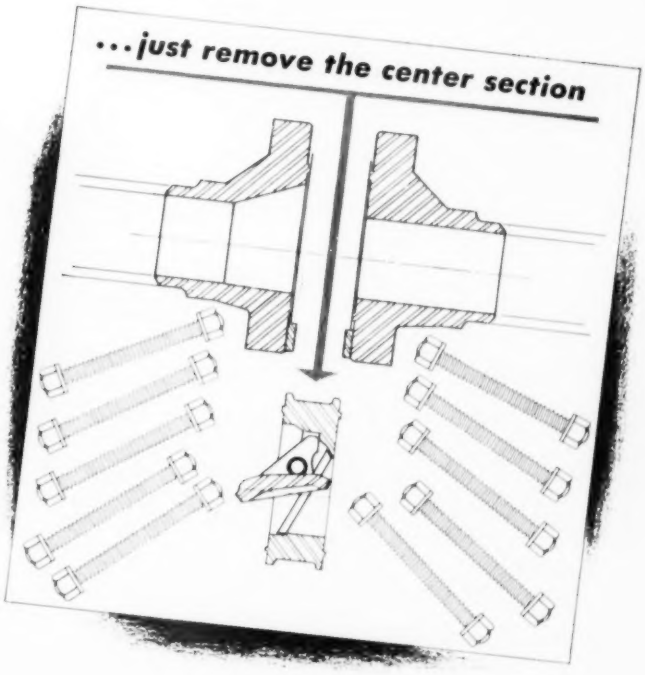
NO NEED to cut this valve out of a Welded Line

...it's a CHAPMAN 3-PIECE TILTING DISC CHECK VALVE

Remove studs between inlet and outlet ends. Then the whole center section can be slipped out *as a unit* . . . and quickly and easily replaced. Figure the savings for yourself!

Here, Chapman design gives you the smooth operation and quiet closing of the 2-piece Tilting Disc Check Valve . . . with the unique advantage of practically immediate interchangeability of "the works." And *only* Chapman makes this complete line of Tilting Disc Check Valves. Send for your Chapman "Check Book" — *now!*



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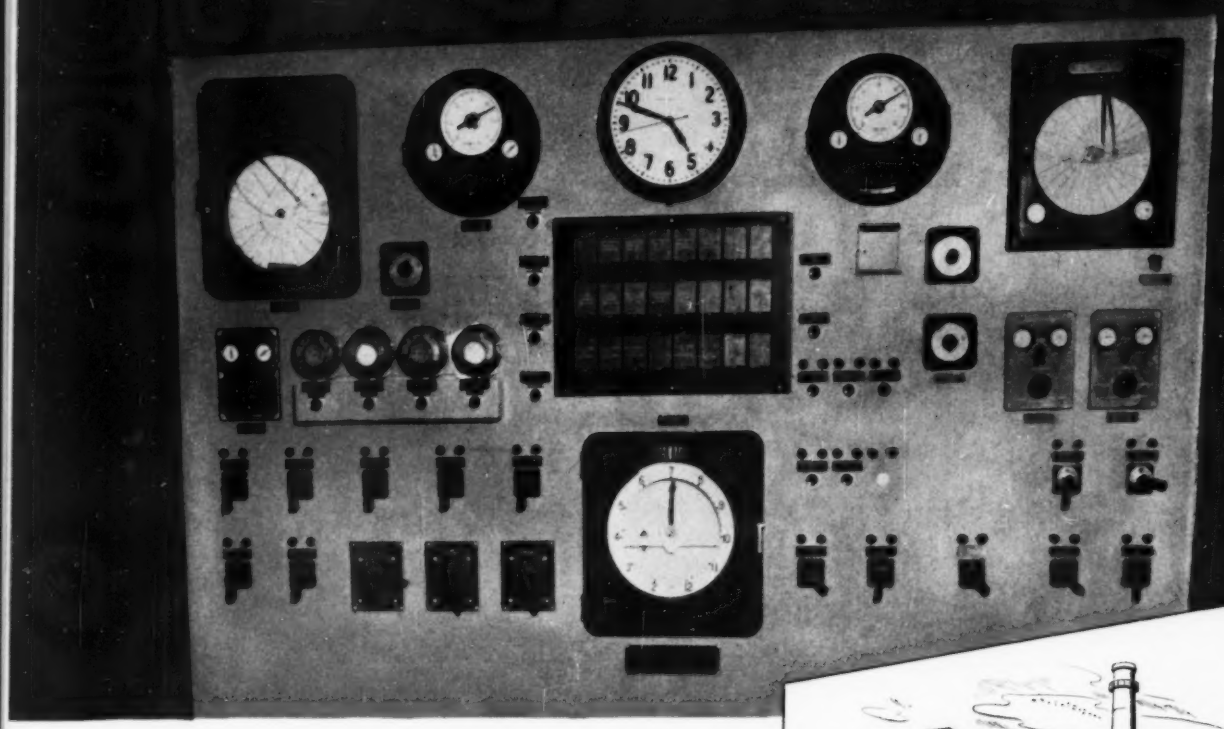

Atlantic City Electric Company selects PERMUTIT WATER CONDITIONING with *centralized, automatic control*

Greenwich Station. Normal steam capacity: 460,000 lb per hr. Engineered and constructed by Burns and Roe, Inc., New York City.

To FILL *changing* demand for 100% makeup with highest purity feedwater requires the best of equipment and a degree of efficiency obtainable only with modern automatic control.

At the Greenwich Station, instrumentation — centralized in Permutit cubicles — provides this control. The water-treatment plant supplies makeup that meets requirements for two 650 psig boilers operating under *wide ranges* in load . . . for steam output and turbo-generator exhaust must also fill the changing process-steam needs of a very large, nearby chemical plant.

TREATMENT METHODS SPECIFIED

Consulting engineers investigated several plans to determine the most efficient and economical means of making Delaware River water satisfactory for two 230,000 lb per hr boilers. Final decision was to treat the water with *Permutit equipment:* coagulation, silica reduction, filtration, hydrogen-sodium-zeolite softening, degasification . . . with provision for demineralization if required.

REQUIREMENTS FOR COMPLETE CONTROL

Mounted on the Permutit central control board are flow controllers and loss of head gauges for each filter; flow recorders, level indicators, alarms, timing devices, etc. A pH indicator assures proper blending of the sodium and hydrogen-zeolite softened waters. After setting flow rates, timing elements, etc., this entire Permutit water-treatment system operates *automatically!*

Find out how Permutit can solve your water problems. Write to THE PERMUTIT COMPANY, Dept. PFll, 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT®

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